MA9402V1

ECS Evaluation Packages Strategic Plan

White Paper

Working paper - Not intended for formal review or Government approval.

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Abstract

Evaluation Packages are an early delivery mechanism that allow portions of ECS functionality to be placed into the hands of selected users for evaluation and design iteration in advance of formal system releases. As such, they help avoid late discovery that what has been produced is not that which is desired.

This white paper describes the plan and process for the delivery and evaluation of the ECS Evaluation Packages (EP). The objectives of this document are to 1) provide an overview of the EP process to set the context for planning, 2) define a projected plan for the content of each evaluation package delivery, and then 3) define the detailed process structure for development, test, installation, evaluation, and maintenance of those deliveries. This document is intended to evolve, reflecting the continuously improving EP process, based on lessons learned during the incremental development, prototyping, studies and evaluation process.

This version of the white paper was prepared at the beginning of development for EP4. It will serve as the strategic plan for EPs until updated at the beginning of development for EP5.

For a rapid overview of the EP plan see the following items :

- EP Schedule (Figure 2-2)
- EP Lifecycle (Figure 2-5)
- Development Methodology by Subsytem (Table 3-2)
- Summary of Content by EP (Table 3-3)
- SDPS Content (Figure 4-1)
- CSMS Content (Figure 5-3)
- EP Evaluations: Methods and User Groups (Table 10-1)

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1. Introduction

1.1 Purpose

This white paper describes the plan and process for the delivery and evaluation of the ECS Evaluation Packages (EP). The objectives of this document are to 1) provide an overview of the EP process to set the context of planning, 2) define a projected plan for the content of each evaluation package delivery, and then 3) define the detailed process structure for development, test, installation, evaluation, and maintenance of those deliveries.

1.2 Related Documents

This document was developed using the concepts and processes described in several ECS White Papers, ECS CDRLs and EOSDIS Planning Documents. The documents that are related to this EP Strategic Plan are:

107/MG1	Level 1 Master Schedule, Current Issue
108/MG2	Intermediate Logic Network Diagrams, Current Issue
201/SE1	ECS System Engineering Plan, Current Issue
FB9403V3	ECS Release Plan Content Description, June 1994

1.3 Organization

Summary descriptions for each section of this white paper are provided in Table 1-1.

1.4 Review and Approval

This White Paper is an informal document approved at the joint ECS Office Manager level. It does not require formal Government review or approval; however, it is submitted with the intent that review and comments will be forthcoming. It is expected that the ETMs for each ECS segment will be interested in reviewing this paper and in providing feedback to the authors to assist in guiding the EP process.

This draft version of this white paper is being circulated as part of the objectives planning for EP4. The EP4 Objectives Review is scheduled for August 25, 1994. This paper is being distributed prior to the review to provide the reviewers a strategic perspective. The EP4 Objectives review will concentrate on EP4 objectives using associated review materials. Comments on this paper should be directed to George Percivall outside of the review via the contacts listed below. Comments received prior to September 1, 1994 will be incorporated.

The plans and objectives expressed in this White Paper remain valid until superseded by the next release. The concepts presented here are expected to be consistent with the ECS System Engineering Plan, CDRL 201.

Table 1-1. Section Descriptions

	Section	Description
1.	Introduction	Purpose and Organization of this White Paper, Related Documents, and Contacts for further information
2.	EP Process	Description of EP Process including EP Master Schedule, relationship with incremental development and prototypes, detailed description of an EP Life Cycle, and EP evaluators.
3.	EP Strategy Development	Development of EP strategy based upon capabilities required for Release A of ECS. Guidelines for determining content for incremental development are provided.
4.	SDPS Deliveries by EP	An overview of the SDPS development is followed by the SDPS EP strategy and summary descriptions of the content of each EP and Prototype Workshop.
5.	CSMS Deliveries by EP	An overview of the CSMS development is followed by the CSMS EP strategy and summary descriptions of the content of each EP.
6.	Science Datasets and Science Support Scenarios	Description science scenarios to be used for the EP evaluations along with the datasets to be used
7.	Segment EP Interfaces	Timeline for the development of segment-to-segment interfaces required for EPs.
8.	EP Integration and Test	Process and organization for conduction the Integration and Test of EPs.
9.	EP Resources	Description of the present workstations and networks available for EPs
10.	Evaluation Process	Description of the process to be used for eliciting comments on the EPs
11.	EP Maintenance and Operation	Describes the M&O tasks of EPs and the responsible organizations.
	Acronym List	

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2. EP Process

2.1 Evaluation Packages Overview

The ECS Team has defined a multi-track development approach that includes an incremental development track that will build the full functionality of portions of the ECS in parallel with formal-track development of other portions of ECS. Evaluation Packages are the early delivery mechanism that allows portions of ECS functionality (incremental and prototype) to be placed in the hands of selected users for evaluation and design iteration in advance of formal system releases. Evaluation Packages bring together increments and prototypes for deployment and evaluation (Figure 2-1)

Evaluation Packages (EPs) provide predefined dates for delivery of individual increments and selected prototypes (Figure 2-2). The planned content of each EP delivery is documented in this white paper. The feedback from one EP influences the objectives and design for the next. Each EP builds upon and expands the capabilities of previous EPs, until the last EP in the series supporting a formal release, when the software is migrated to the formal track for integration, acceptance testing, and formal delivery.

Each EP may incorporate selected prototyping efforts from the ECS segments. Prototypes are selected for inclusion in an EP primarily based upon their function and content and their relation to the goals of the EP, and on their need for evaluation by multiple users in the community.

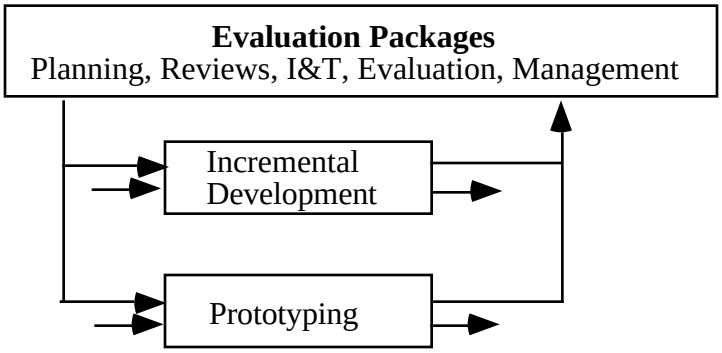

Figure 2-1. Evaluation Packages: Delivery Mechanism of Increments and Prototypes

Section 2.1 provides the summary EP Schedule and Milestones (Section 2.1.1) along with overviews of Incremental Development (Section 2.1.2) and Prototypes (Section 2.1.3). The EP Process (Section 2.2) describes the process by which increments and prototypes are brought together to form EPs.

2.1.1 EP Schedule

Key activities and milestones associated with the overall Evaluation Package process leading to Release A are shown in Figure 2-2 and Table 2-1. The EP Schedule reflects a maturing of the EP process requiring more complexity to meet the various needs which EPs satisfy. In particular, are two items: 1) Delivery of CSMS functionality prior to SDPS, and 2) the addition of SPDS EP Workshops. CSMS will be delivering functionality early for EP4 to support SDPS incremental and prototype developments for EP4. In EP5, CSMS will be delivering infrastructure to support SDPS EP6 development along with CSMS specific items. The SDPS EP Workshops are the result of the desire to feed comments on an EP directly into the next EP. In order to get the direct feedback and to provide the user evaluation needed for the incremental development, SDPS EP workshops have been added. These workshops will allow collection of user evaluation with direct developer assistance, thereby avoiding the more rigorous I&T required for and EP deployment and independent evaluation.

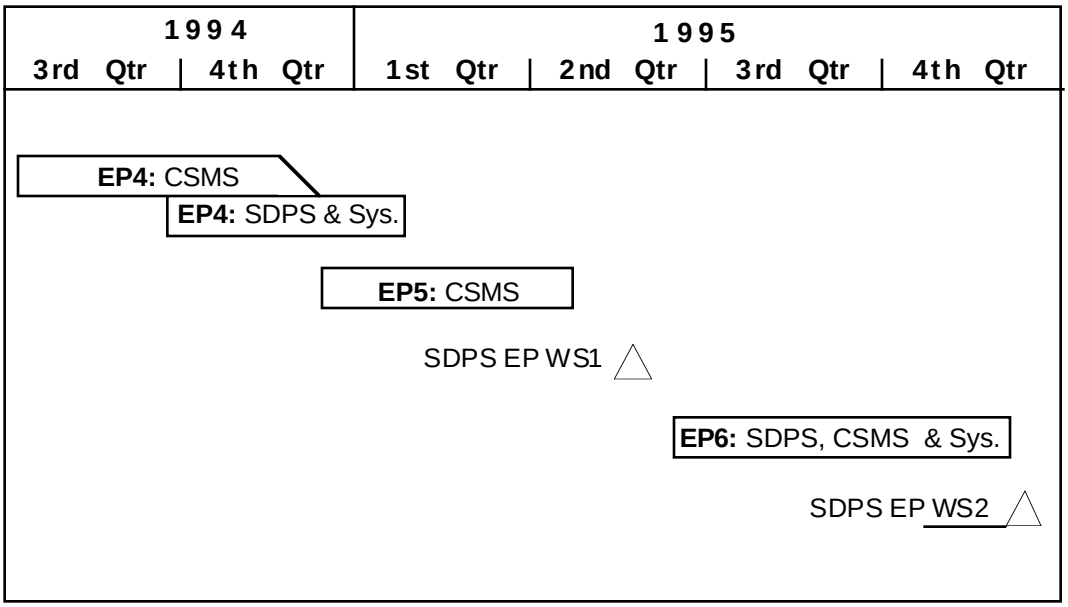

Figure 2-2. EP Schedule Leading to Release A

Table 2-1. Key EP Events Leading to Release A

Event	Date
EP4 Development	
- EP4 Objectives Review	08/25/95
- EP4 Test Readiness Review (TRR)	11/02/94
- EP4 Readiness Review (EPRR4)	01/04/95
Release A CDR	04/01/95
EP5 (CSMS)	
- EP4 Objectives Review	1/95
- EP4 Test Readiness Review (TRR)	04/01/95
- EP4 Readiness Review (EPRR4)	05/01/94
EP Prototype Workshop 1 (SDPS)	05/01/95
EP6 Development (CSMS, SDPS & System)	
- EP6 Objectives Review	06/01/95
- EP6 Test Readiness Review (TRR5)	09/01/95
- EP6 Readiness Review (EPRR5)	11/01/95
EP Prototype Workshop 2 (SDPS)	12/01/95
Release A TRR	04/01/96

2.1.2 Incremental Development Overview

Incremental development is described in detail in Section 8 of the ECS Systems Engineering Plan (ECS Document 194-201-SE1-001, June 1994). A terse summary is provided here to aid the understanding of the EP Process in Section 2.2.

Instead of a single waterfall of sub-phases, the incremental process uses multiple incremental development cycles, including user evaluation prior, to integration with formally developed software. Figure 2-3 illustrates how multiple incremental development cycles support a release. The number of increments shown in Figure 2-3 is illustrative with the specific number of increments for a release based on specific release plans.

The incremental development approach involves a small customer selected segment of the user community in the process of product evaluation. Capabilities are demonstrated frequently in a "build and test a little, evaluate a little" development progression. Software built in one increment supersedes and provides more capabilities than the software in the previous increment. The incremental development process leads up to the integration of incrementally developed components into a formal release via conformance to design standards and the migration of documentation into the formal process.

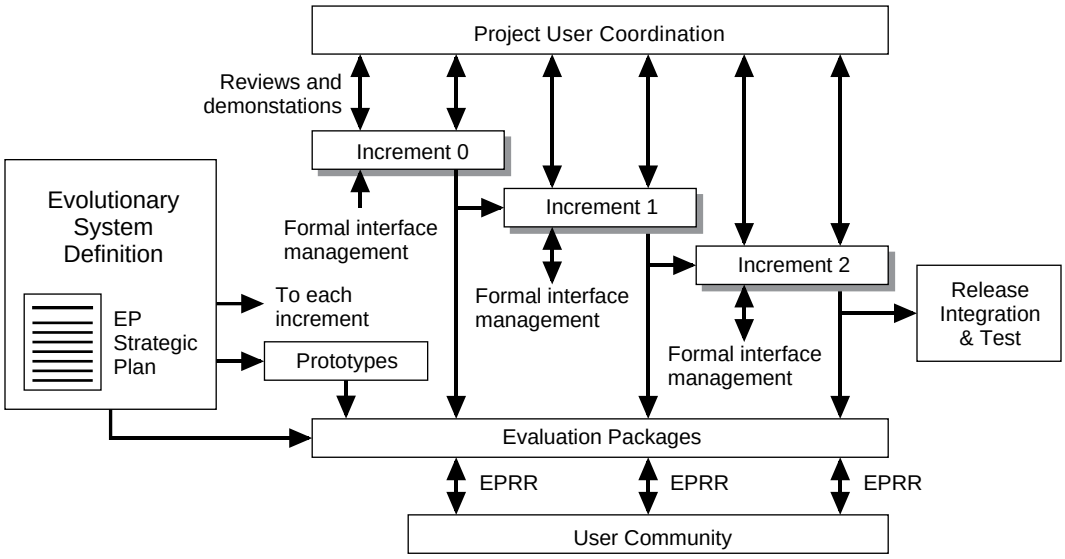

Figure 2-3. Incremental Developments for a Release

A single incremental development cycle has stages similar to those found in formal development (see Figure 2-4). An incremental development cycle is composed of the following stages: 1) Objectives Definition, 2) Design, 3) Implementation, 4) Integration and Test, 5) Maintenance and Operations, and 6) Migration. Incremental development starts with objective definition and Level 3 requirements trace, generally corresponding to requirements development in the preliminary design stage of formal development.

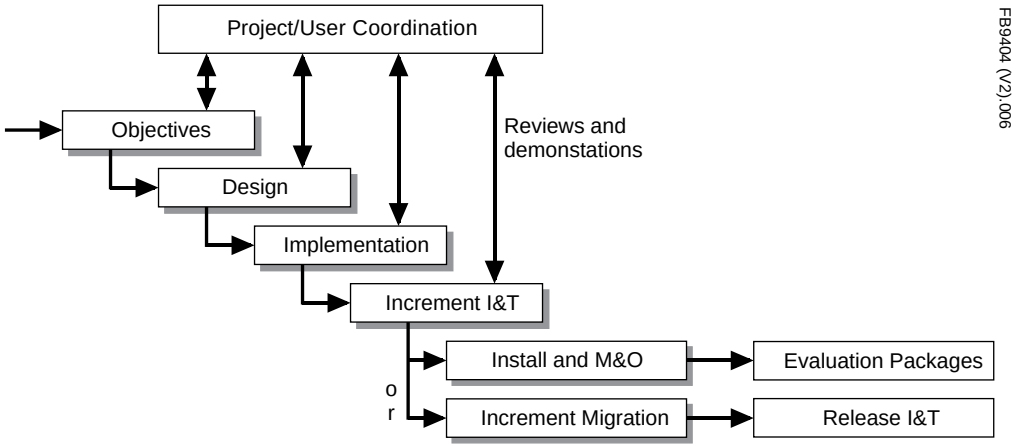

Figure 2-4. Incremental Development Stages

Both incremental development and formal development have design, implementation, integration and test, and maintenance and operations stages. However, the contents of each of the above cycles differs between formal and incremental development due to the iterative nature of the incremental track. In particular, documentation generated during incremental development is initially produced in a more streamlined fashion, e.g., in development "notebooks" maintained by developers, in white papers, in briefing charts, and in system demonstrations. Also, reviews are accomplished as a part of regularly scheduled coordination meetings.

Objectives notebook developed during Objectives stage shall be developed in accordance with the ECS Project Instruction for Incremental Track Objectives Folder (Draft PI, Number to be assigned).

Other folders developed on the incremental track may be in the format of white papers, briefing charts, or annotated charts, available electronically or hard copy, as appropriate to convey the information. To allow for ease of generation of formal documentation, priority is given to using a template during the increment that is in the formal documentation format

Peer Reviews conducted during the Design stage shall be conducted in accordance with the ECS Project Instruction for Inspections and Reviews (PI Number SD-1-004).

2.1.3 Engineering and EP Prototypes

Prototypes which are utilized for EP purposes may be of two types: 1) Engineering Prototypes and 2) Development Prototypes. Engineering Prototypes are developed in accordance the ECS Prototyping and Studies Plan (ECS Document 194-317-DV1-001, May 1994). Development Prototypes for EPs follow a similar process with one major exception: this EP Strategic Plan White Paper is used as the planning record instead of the Prototype Database defined for Engineering Prototypes. A terse summary of the prototyping process is provided here to aid the understanding of the EP Process defined in Section 2-2 (see ECS Prototyping and Studies Plan for a complete description).

Figure 2-5, Prototypes and Studies Process, shows the identification, selection, execution/ evaluation and incorporation steps of the prototypes and studies for Engineering Prototypes on the ECS project. Identification is the process of proposing a prototype or study for implementation. Selection is the process of reviewing the prototype and study proposals for approval by the Prototype Review Board or ETMs. Execution/evaluation is the process of implementing the prototype and reporting on the progress of prototype activities to the project. Incorporation is the process of feeding results back into the design and implementation process in the most effective manner. Table 2-2 provides a summary description of each step.

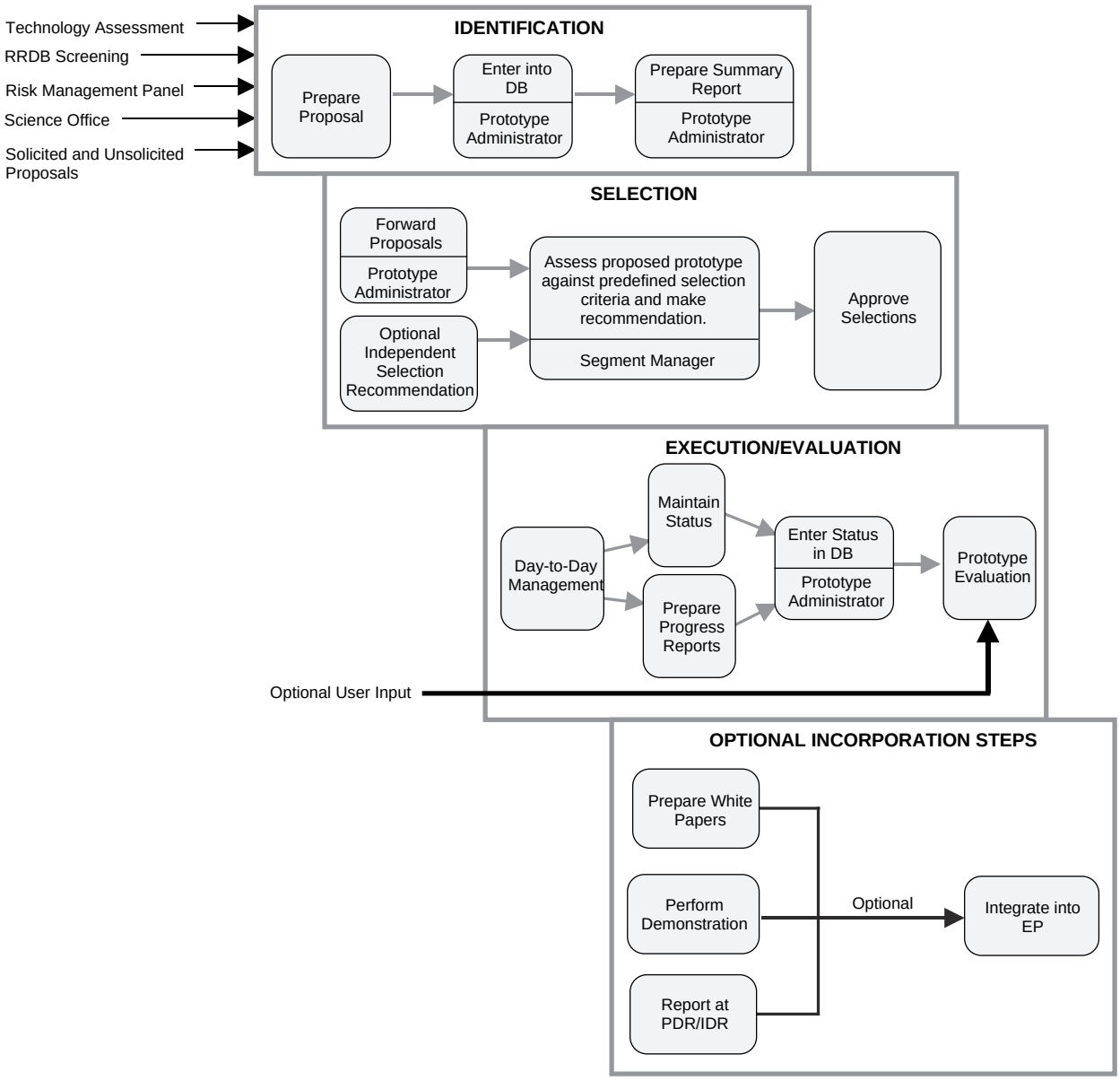

Figure 2-5. Prototypes & Studies Process

Table 2-2. Prototype Process

Step	Description for Engineering Prototype	Description for Development Prototype
Identification	• Short proposal (one to two pages) prepared by organization proposing the prototype • Prepared in accordance with Prototype and Studies Plan (317/DV1) • Submitted to Prototype Administrator for entry into prototype database	• Modified version of the Objectives Folder which documents areas of uncertainty in the design of the component
Selection	• Prototype Administrator forwards proposal and funding source to selection review personnel • Approval authority determined by funding source • participants to implement and evaluate the prototypes are listed	• Proposal reviewed at EP Objectives Review • Participants and implementers determined by EP process
Execution/ Evaluation	• Prototype Lead responsible for managing day-to-day tasks • Quarterly Prototype Status Reports in conformance of DID 318/DV3 • Status prototype maintained by Prototype Lead and forwarded to the DTR and Prototype Administrator • User involvement through demonstrations and inclusion into EPs where appropriate	• Segment EP managers responsible for managing day-to-day tasks • Status part of EP Life Cycle Reviews (see section 2.3) • User involvement through EP process
Incorporation	• Determined by Development Team Representative and Evaluation Team Leader • If prototype results are to be used in ECS implementation, a complete set of required documentation and testing must be accomplished to support the requirements of the incremental or formal development track.	• Determined by Development Team Representative and Evaluation Team Leader • Documentation for incremental development developed as part of EP cycle in which the prototype becomes an increment

2.2 EP Process

EPs are a delivery and evaluation mechanism for incremental and prototype developments. The discussions which follow speak of the “EP process” for uniformity in this paper, but it must be remembered that the incremental prototype products are the items of development. The EP process provides an integrating and complete life cycle structure for the prototypes and increments.

The challenge for EP life cycle design is to provide just the necessary amount of structure without creating an administration overload that totally removes the freedom to react to objectives and design changes dictated by evolving circumstances. That challenge has been

accomplished with the design of an EP life cycle that adopts selected practices from more traditional engineering methods, and applies them on the rapid prototyping form originally intended. These include the following features:

- Objectives setting and review.
- Design coordination and review.
- Documentation in Program Development Folders.
- In-process demonstrations and peer reviews with feedback to adjust implementations.
- Frequent EP team status assessments and planning adjustments.
- Early participation of test personnel in product testing.
- Progressive, semi-formal, integration and test.
- EP Consent to Ship Reviews.
- EP Evaluation Readiness Reviews.

Experience to date indicates that the minimum time to produce meaningful content in an EP is about six months, and that evaluation of the EP will require an additional two months including time for data analysis and results sharing. The actual time for a given EP will depend upon the defined content of that EP.

The structure of each EP life cycle is shown in Figure 2-6, EP Life Cycles. A time scale in weeks and months from start date provides a relative time reference to events. The duration of the cycle for each EP is minimized by parallel design prototyping with more formal design work, and by overlapping the evaluation period of the first EP (EPn) with the start up of the next (EPn+1). Extra discipline must be applied in the latter instance to assure that the evaluation results from EPn actually do make maximum contribution to the evolution into EPn+1.

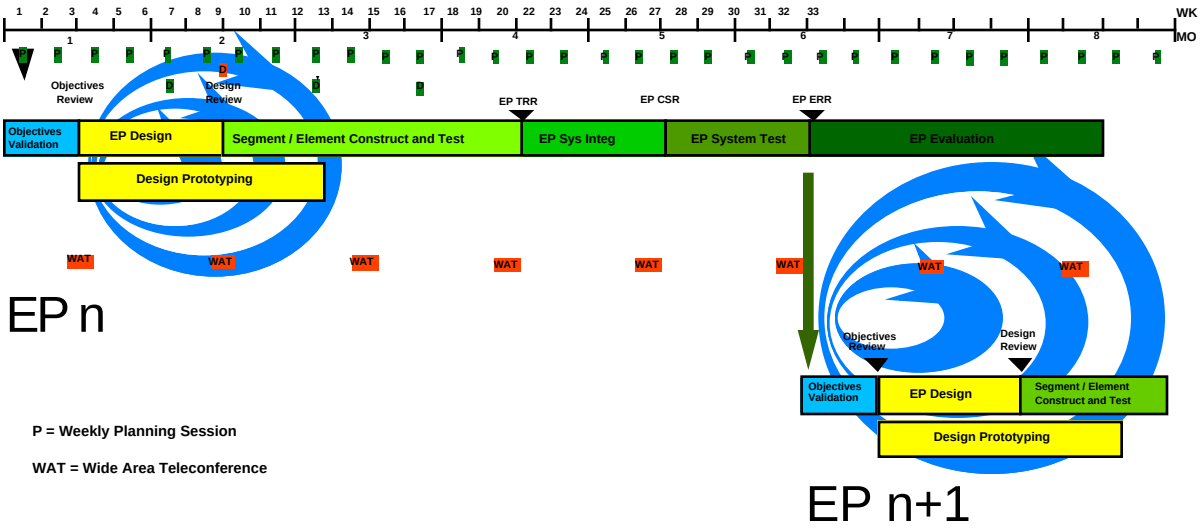

Figure 2-6. EP Life Cycles

Maximum visibility into the EP process for all interested parties is our goal, and participation by ESDIS, DAAC, and user personnel is encouraged. The following activities are included in the EP Life Cycle design to afford the visibility desired.

- EP Planning and Coordination Sessions - Weekly discussion of status against plans, accomplishments, problems encountered, and near-term activities for each EP participant.
- Wide-Area Telecons - Teleconferences, including interested personnel, of monthly reviews of status against plans, accomplishments, problems encountered, and mid-term activities for each EP participant. Emphasis will be placed on larger issues of interest to the broader scope of participation.
- Demonstrations - Informal, as well as more structured, demonstrations of accomplishments to date will be included in the EP process to afford every opportunity for customer and user input to the evolving design implementations. Informal demos can take place whenever a significant new level of changes has been implemented and can occur whenever personnel are available to conduct and view the demos. More structured demos will be planned at key points in the life cycle where they make sense for the items being developed. As a minimum, structured demos will be included in the Semi-Formal Reviews conducted in the later stages of I&T.
- Semi-Formal Reviews - The EP life Cycle includes sufficient management control to assure that EP developments follow agreed to methodology and standards, make acceptable progress toward agreed to functionality and schedules, and that the products deployed include the quality required in ECS products. This control is offered through semi-formal reviews. They are "semi-formal" in that they entail no advance hardcopy, use relaxed-format presentation materials, have no RID process, and no compulsory attendance list (except for developers). These reviews include an informal Objectives Review, Design Review, Consent to Ship Review, and an EP Evaluation Readiness Review. Each is described in purpose and content below.
- Peer Reviews - EP developments are performed in a small-team work group environment with daily interaction and informal coordination of designs, implementation requirements, and accomplishments Ad Hoc technical interchange discussions are a normal part of this process and assist the coordination process. More structured peer review and coordination sessions are called by EP management whenever issues are uncovered by this process or in the weekly planning and coordination sessions.
- Segment ETM Status Meetings / demos - Each segment has its customer counterpart and established review meetings. EP accomplishments are routinely reported and demonstrated in these forums with pointed focus on the special concerns of each segment.

Each of the phases of the EP life cycle, shown in Figure 2-6, is described below.

2.2.1 Objectives Validation

The development cycle of each EP begins with a review of the previously defined goals and objectives for the EP (as documented in the current version of this paper). Goals and objectives are updated with lessons learned from recent EP development and test activities, and with results coming from the evaluation of the EP currently in evaluation. The main items to be revalidated include:

EP Objectives - The purposes to be achieved by deploying the services at this time, as contained in the EP Strategic Plan.

Incremental Questions and Metrics - Detailing of EP Objectives as contained in the Incremental Objectives Folder.

Process Objectives - The development management and administrative process objectives that are to be explored in the EP.

Process Capabilities - The detailed process procedures to be implemented to achieve the process objectives.

EPn COTS Requirements - Definition of the COTS hardware or software required to implement the EP, assurance of its availability, or initiation of its procurement.

2.2.2 Objectives Review

A semi-formal review involving ESDIS, ECS Science Advisors, DAAC representatives, all developers, test and integration, and support functions. Proposed goals and objectives for the current and projected EPs are presented, discussed, and agreed upon. Agreements are documented following this review and published in an update to this paper.

2.2.3 Design

Design Process - Decomposition of functions into units of architecture (functions - threads - builds - modules / objects, etc. as appropriate), and identification and definition of interfaces therein.

Design Prototyping - coding of elements of functionality for early experimentation with implementations.

Design Documentation - Development Folders

- Interface Control Documents

- COTS Requirements Table (specs)

2.2.4 Design Review

The EP Design Review is a semi-formal review involving ESDIS, ECS Science Advisors, DAAC representatives, all developers, test and integration, and support functions. Proposed designs for the items included in the EP are presented in vugraph form, discussed, and agreed upon. Agreements are documented in updates to the presentation vugraphs and included in the

development folders following this review. A collected set of updated and commented presentation materials is published for all participants and becomes the design baseline for the EP.

Peer Reviews conducted during the Design stage shall be conducted in accordance with the ECS Project Instruction for Inspections and Reviews (PI Number TBD).

2.2.5 Construct and Unit Test

Construction of software begins with approval of designs and interface definitions. Software is written to ECS software standards to assure reusability with little rework. All modules are created, updated and maintained under the ECS software configuration management system. The build/thread methodology is followed to create and integrate modules in meaningful sequences building toward the design functionality intended. At the point where predefined threads have been successfully tested to allow the integration of those threads into a Build, an informal TRR is held to transition software ownership from developer control to EP Integration and Test Organization control. This is accomplished by "promoting" the modules in the CM library. Design changes, which were encouraged for evolution until this point, are ended at TRR.

2.2.6 Design Freeze

Design changes must be suspended in even the most free development environment at some point in time to establish a stable baseline for test and integration of multiple system components. The design freeze for EP software occurs at the TRR associated with transfer of CM control from development to EP Test. Subsequently, the only software changes allowed are to fix recorded discrepancies.

2.2.7 EP Integration and System Test

EP integration and system test are performed in two phases divided by a Consent to Ship Review. Activities in these phases are performed by the EP I&T group made up of personnel from the I&T organizations of the segments and the SI&P Office. Leadership of the group rotates with each EP. Configuration management responsibility for this phase belongs to the test group, and a formal Discrepancy Reporting (DR) tool is used to prioritize and track problems discovered. Daily activity review and planning sessions, overseen by EP management, and attended by test, and development people, are held during this phase.

EP Integration - Integration is performed at the EDF, bringing together the software builds from the elements and segments, in the specified computing and communications environment, into a functional whole.

Consent to Ship Review - This review is held when the integration testing indicates that the EP is functioning well and all DRs which might compromise its operation have been resolved. The purpose of the CSR is to demo the system to ECS, ESDIS and DAAC representatives, to review the test status with them, and to obtain approval to move the EP to broader visibility by installing it at the DAACs for system-wide testing.

System Test - The system test period includes EP installation and check out by the test group, training and familiarization of the DAAC liaisons and staffs, and a system-wide exercise of the EP with all DAACs participating. The purpose of the system exercise is to assure the soundness of the EP under multi-user loads and to demonstrate readiness to support the EP evaluation phase.

2.2.8 EP Readiness Review

The EPRR is conducted at the end of the system-wide exercise to review occurrences in the exercise. If it was successfully concluded (no unexplained, or priority 1, (show-stopper) problems), the EP is declared ready for use in the evaluation environment by its intended evaluators.

2.2.9 Evaluation

EPs will be evaluated by three user groups with data collected via three evaluation methods. The three user groups are science users, operations and users services, and ECS developers. The three evaluation methods are Usability Testing (UT), and Evaluator Preference Survey (EPS) and API evaluation. Each of the user groups and the evaluation methods are described in Section 10.

The life cycle for an EP is completed as its evaluation is finished and the results from that evaluation feed into the beginning phase -- Objectives Validation - of the next EP. The first EP remains installed at the DAACs during the Development and Test phases of the next EP to continue evaluative use in that user environment. Feedback continues to influence the development of the next, and later generation, EPs.

3. EP Strategy

EP Strategy was developed using a subset of the content required for Release A and by the needs of the incrementally development items for user evaluation. This section provides the link to the ECS Release Plan with respect to the content suited to EP evaluation and incremental development (Section 3.1). Additional considerations for EP content are based on incremental development by segments (Section 3.2). An overall summary of the EP strategy includes the content provided by each segment, associated data and evaluation (Section 3.3).

3.1 EP Strategy Development

3.1.1 Formal Releases Drive EP Planning

This strategic plan documents the objectives and deployment of the EOSDIS Core System (ECS) EPs identified in the ECS Master Schedule supporting ECS Release A. EP Strategy Formulation described in this section is based on the a subset of the functionality defined for Release A in the ECS Release Plan (Figure 3-1). This section explains how specific driving requirements for ECS development relate to the EP strategy.

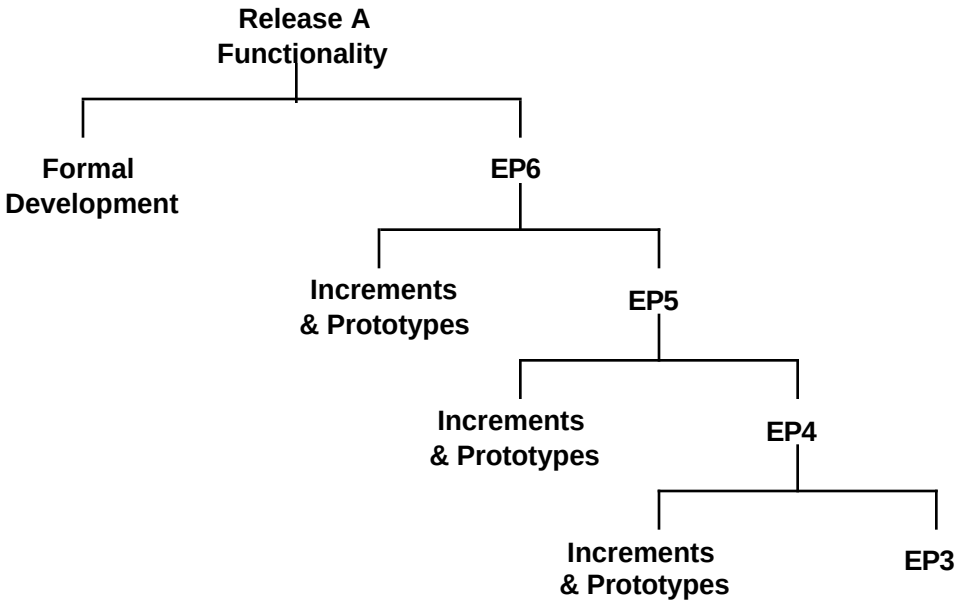

Figure 3-1. EP Strategy Formulation

3.1.2 Guidelines: Formal vs. Incremental Development

Purposes of the formal and incremental development tracks is stated in the ECS SOW as follows:

Incremental Development may be used for those areas of the system where requirements are less well understood and iteration of requirements and design is anticipated with user evaluation. Formal Development shall be used where requirements are more mature and stable. Incremental development may also be used in COTS intensive parts of the system and to develop system infrastructure in support of other incremental developments.

Also from the ECS SOW is the purpose of the Evaluation Packages:

Evaluation Packages are a delivery mechanism for early deployment of Incremental Developments and selected Prototypes. The purpose of the Evaluation Packages is to solicit user evaluation early in the development cycle.

It is with these guidelines in mind the that the strategy for EP is formulated in the next sections.

3.1.3 Release Plan as basis for EP Strategic Planning

The basis for EP Strategic Planning is the ECS Release Plan. The ECS Release Plan has the following structure and logic:

- Identification of External Driving Requirements (Section 5)
- Assignment of the Driving Requirements to Releases (Table 7-2)
- Identification of the Segment Functions needed to satisfy the Driving Requirements (Section 6 Tables)
- Detailed Identification (Service Class level) of Segment Services by Release (Section 10)

The structure and content of the release plan is used to determine driving requirements for the EPs in the following steps:

- Based on Section 5 of the Release Plan and the guidelines listed in the previous section of this white paper, Identify the External Driving Requirements which have “Uncertainties”
- Based on the previous step and the allocation of driving requirements to release (Table 7-2 in the Release Plan), Identify Release A, “Uncertain” Driving Requirements. (The results of this step are listed in the next section of this white paper.
- The Release A, “Uncertain” Driving Requirements are then an input to the segment planning for incremental and prototype developments which along with development considerations were used to develop Tables 5-1 and 6-3.

3.1.4 Release A, “Uncertain” Driving Requirements

The items listed in Table 3-1 are the result of the EP Strategic Planning process described in the previous section. These are a subset of the overall ECS External Driving Requirements for Release A. the complete list is in the ECS Release Plan.

The items in Table 3-1 can be found in the SDPS Strategy, Table 4-1, with the exception of V0 Data Migration. V0 Data Migration is a separate task being conducted by the ECS contractor. EPs are dependent upon V0 Data Migration as described in Section 6.

Table 3-1. Release A, "Uncertain" Driving Requirements

V0 Interoperability
User Services - Search Using Combinations of Logical Operators - Display of Data Timeline (metadata visualization) - API for Update, Query and DBA Utilities (inventory, guide directory) - Data Visualization Capabilities - On-line User Survey at all Sites
V0 Data Migration

3.2 Incremental Development

Although, determination of which elements of ECS are best suited for incremental development is based on requirements volatility, it is subsystems which are developed incrementally not requirements. The state of the requirements and the anticipated interaction with users with respect to the requirements provides indications to which portions of the system are best suited to incremental development. The choice of what is developed incrementally is done on a system partitioning basis, e.g. subsystem by subsystem basis. With respect to EP strategy, selecting subsystems to be developed incrementally means that there is additional EP content beyond the content based solely on requirements uncertainty (see Section 3.1). Additional issues concerning development, e.g. timing of critical prototypes and COTS selection, are discussed in Section 4.1 for SDPS and 5.1 for CSMS.

A summary of the development approach and support of EPs by ECS subsystem is shown in Table 3-2. The main area of incremental development and associated EP evaluation, are those areas in most direct contact with the science users, e.g. SDPS client, Interoperability, Data Management. The Data Server will developed in part incrementally and the remainder using the formal methodology. This ambiguity is resolved at the next level below subsystems in the system partitioning. Although the CSMS subsystems ISS and MSS are developed formally, the EPs rely on support from these subsystems.

Table 3-2. Development Methodology by Subsystem

Segment	Subsystem	Development Methodology	EP Support (If not incremental)
SDPS	Client	**Incremental**	
SDPS	Interoperability	**Incremental**	
SDPS	Data Management	**Incremental**	
SDPS	Data Server	Part **Incremental**, Part Formal	
SDPS	Ingest	Formal	
SDPS	Planning	Formal	
SDPS	Data Processing	Formal	
CSMS	CSS	**Incremental**	
CSMS	ISS	Formal	**Yes**
CSMS	MSS	Formal	**Yes**
FOS	User Interface	Formal	
FOS	Planning & Scheduling	Formal	
FOS	Data Management	Formal	
FOS	Command Management	Formal	
FOS	Command	Formal	
FOS	Resource Management	Formal	
FOS	Telemetry	Formal	
FOS	Analysis	Formal	

3.3 Summary of EPs

This section provides an overview of the content of the EPs and EP Prototype Workshops. Table 3-3 summarizes the content for each segment, the associated data and evaluation methods. Detail on SDPS content can be found in Section 4. Detail on CSMS content can be found in Section 5. Detail on data sets for EPs can be found in Section 6. Detail on evaluation methods and evaluators content can be found in Section 10

Table 3-3. Summary of Content by EP

	SDPS Content	CSMS Content	Data	Evaluations
EP4	- EOSView - Advertising Service - Scientist Workbench	- Network Management - Access Control Lists - DCE Encapsulation - Trader Service - Non-DCE user	- EDC & NSIDC Directory - DAAC Sampler for Browse	- Usability Test and Survey of Science Users - Usability Test of Operations Users
EP5	(none)	- Developers Tools and Environment - Management Services - ORB	(not applicable)	- API evaluation by developers - Usability Test of Operations Users
WS1	- Inventory, Guide, Directory Search (prototype)	(none)	(same as EP4)	- Usability Test of Science Users
EP6	- Browse, - LIM - ECS to V0 Interoperability	- Event Services - Management Services - ECS to V0 Interoperability	- TBD Directory - V0 Guide - EDC Inventory - Limited EDC, V0, TRMM	- Usability Test and Survey of Science Users - Usability Test of Operations Users
WS2	- Product Access - Processing Request - Request/ Results status	(none)	(same as EP6)	- Usability Test of Science Users

4. SDPS Deliveries by EP

4.1 SDPS Development Plan Overview

The purpose of this section is to provide an overview of the SDPS plan for the incrementally developed components that will be released via an Evaluation Package (EP), as well as a plan for the prototyping components that will be released via an EP. The planned development process is more specifically defined in the following documents : the Software Development Plan for the ECS Project, the System Engineering Plan, and the Incremental Development Plans. This section will focus on the components destined for EP incorporation, rationale for development track allocation, and schedule and dependencies considerations.

4.1.1 SDPS Subsystems

The SDPS functions have been grouped into subsystems, which provide a method for a logical structure of the system design. Each subsystem is comprised of collections of related functions, which are in turn are organized into SDPS services. Each type of SDPS service consists of a set of software design objects. The ECS System Design Specification Section 4 details each SDPS Subsystem. An overview of each SDPS Subsystems/components that will be developed incrementally or prototyped for EP incorporation, and a brief description of each subsystem follows (see the System Design Specification (ECS Document 194-207-SE1-001) for more detail):

- **Client Subsystem**

  This subsystem provides the user interface to the SDPS. It consists of a Scientist Workbench and a Desktop Component. The Scientist Workbench contains various tools, and the Desktop provides convenient methods for organizing the user interface objects, and setting interface preferences.

- **Interoperability Subsystem**

  SDPS is architected as a collection of distributed applications. They use the functions of the CSMS Communications Subsystem and Internetworking Subsystem to cooperate with each other. The Advertising Service is the SDPS component of the Interoperability Subsystem.

- **Data Management Subsystem**

  This subsystem provides the functions which are needed to locate, find and access earth science and related data in the ECS databases and in data systems with which ECS interoperates. This subsystem includes distributed search and retrieval functions called the Distributed Information Management (DIM) functions, components which act as each site's gateway into its earth science databases called the Local Information Management (LIM) functions, and a Data Dictionary (DD) function which users can access to obtain explanation of available data.

- **Data Server Subsytem**

  This subsystem provides the physical storage access and management functions for the ECS earth science data repositories. It can be accessed directly by other subsystems, or by the Data Management subsystem for distributed searching. Only the Data Server Service and the Data Type Service components will be developed incrementally. The other Data Server subsystem components, that interface with the Data Server and Data Type incremental components, will be prototyped during the increment.

4.1.2 Development Track Allocation

The SDPS subsystems/components that are allocated to the Incremental Development track are those where requirements are less well understood and iteration of requirements and design is anticipated, and those subsystems/subsystem components which will use COTS extensively. The Client Subsystem requires both DAAC and Science community iterative interaction to understand requirements and is expected to be COTS intensive. The Data Management Subsystem is expected to also require iteration of requirements and design. The Advertising Service of the Interoperability Subsystem will require DAAC/Science community iterative interaction. The Data Server Subsystem is expected to be COTS intensive and is needed in order to provide functionality to the Client, Data Management, and Advertising components.

4.1.3 Release Planning and Dependencies Considerations

The Release Plan White Paper Section 13.2 depicts the Release Schedule in Figure 13.1-1 showing that there are about 20 months from now until Release A TRR, in which to develop these Incremental Subsystems. Considerations of the components/objects that should/could be developed incrementally are: DBMS selection schedule, non-mission critical components, user interface framework components, and distributed search components. In addition, consideration to reducing risks via constructive interaction with scientists and DAAC's (prototyping workshops), and risks of immaturity of object models and user models via iterative implementation, which allow the incremental developer to rework non-mature components before TRR. Taking advantage of the latest vendor products/class libraries is also another consideration when developing incrementally.

4.1.4 Prototyping

Prototyping plans are described in the SDPS Prototyping Plan White Paper. Of those described, only the ESDIS approved prototypes will be performed, and a subset of those will be released in an Evaluation Package (EP) - those that are user visible. In addition incremental developers may demonstrate prototypes prior to actual EP release in prototyping workshops. The following are the SDPS prototypes that are currently being recommended for EP incorporation:

- Client component of the Advertising Service
- Client Scientist Workbench Service (search and access, results, help, and processing request)

The following will also be prototyped as support for the user visible Client components above:

- Data Type Services component of the Data Server Subsystem, specifically the following Earth Science Data Types: guide, granule, product access and browse

4.2 SDPS EP Strategy

As previously discussed, EPs are the delivery mechanism for incrementally developed components and selected prototypes requiring user interaction for sufficient evaluation. Table 4-1 shows the allocation of the capabilities from the SDPS subsystems described in Section 4.1 that have been selected for development via the incremental track and evaluation via an EP. For some prototypes, it is desirable to obtain feedback prior to its deployment in an EP. Table 4-1 depicts these evaluator feedback mechanisms as Prototyping Workshops (PW1 and PW2). The Prototyping Workshops will host focused demonstrations and hands-on evaluation of components for which timely feedback is required before their incorporation into an EP.

While it is true that incremental development is founded on the premise that iteration of design through exposure and procedural evaluation by eventual end-users will provide the feedback required for the refinement of those highly visible components, the subsystems delivered incrementally must interface with other components whose implementation cannot be adequately evaluated by an EP. For these subsystems, there exist specific engineering and technical challenges which are best mitigated by deliberate, focused prototypes or studies in order to provide the optimal solution. In addition, the degree to which an incremental component interfaces with or depends upon a component whose risk is managed through prototyping may be sufficient to require that prototyping be completed before the entire capability is submitted for evaluation to end users. The process through which such problems are identified and selected for prototyping is discussed in Section 3. Table 4-2 shows the SDPS Engineering Prototypes that have completed the prototype selection process and are documented in the SDPS Prototyping Plan White Paper. These prototypes will provide components to an EP, either directly through evaluation package delivery, or indirectly, by feeding into the design of an incremental component. The two tables have been aligned to illustrate the interaction between SDPS prototypes and the increments.

Table 4-1 Allocation of Prototypes and Increments to EPs

EP4 TRR 11/02/94	PW1 5/95	EP6 TRR 9/95		PW2 12/95	REL A TRR 4/01/96
INC 0 **Client** EOSView **Interoperability** Access Control Lists **Prototypes** **Client** Advertising Service (Client component of Advertising service prototype) Scientist Workbench (Client component of EOSDIS prototype) **Interoperability** Infrastructure I/Fs (Interoperability component of Advertising Service prototype)	**Prototypes** **Client** Inventory Search Guide Search Directory Search **Data Server** Data Type Services Inventory Guide Directory	**INC I** **Client** User Profile and Application Defaults Advertising Service Inventory Search Guide Search Directory Search **Data Management** Data Dictionary **Data Server** Data Type Services Inventory Guide **Interoperability** Integration with Infrastructure API **Prototypes** **Data Management /** Data Server I/Fs (Data Server component of Infrastructure prototype)	Text Search Browse User Registration Help (Menu) LIM Directory Text Search **Data Server** Data Type Services Browse ECS to Version 0 Interoperability	**Prototypes** **Client** Product Access Processing Request Request/Results Status Help (Menu) **Data Management / Data Server** Data Type Services Product Access	**Client** Product Access Processing Request Request/Results Status Help (Hypertext) **Data Management / Data Server** Data Type Services Browse Product Access Processing Request DistributionServices Two-Way ECS/Version Interoperability ECS to NOAA Interoperability (TBD MOUs)

Table 4-2 SDPS Prototypes and Studies

PROTOTYPES JUL-DEC 94	PROTOTYPES JAN-JUN 95	PROTOTYPES JUL-DEC 95	PROTOTYPES JAN-JUN 96
Infrastructure Framework			
EOSDIS			
Advertising Service			
Data Type Services			
Earth Science Languages and Protocols			
LIM			
Schema Maintenance			
Data Dictionaries and Vocabularies			

The EPs will provide increasing capabilities for end user evaluation, and will be a combination of components developed incrementally and selected prototypes. The following subsections will summarize the contents of the EPs in Table 4-1, and describes in more detail the incremental and prototyped portions of each delivery.

4.3 SDPS Content for EP 4

EP4 will provide services from increments and prototypes in the following subsystems:

- EP4, SDPS Increment 0, Client Subsystem
- EP4, SDPS Increment 0, Interoperability Subsystem
- EP4, SDPS Prototypes, Client Subsystem
- EP4, SDPS Prototypes, Interoperability Subsystem

The major capabilities delivered as Increment 0 in EP4 will be: 1) The Data Visualization toolkit or EOSView (Part of the Client Subsystem) and 2) Security services be provided via a CSMS supplied API (Part of the Interoperability Subsystem).

4.3.1 EP4, SDPS Increment 0, Client Subsystem

EOSView

EOSView is the data visualization toolkit developed for the viewing and verification of HDF-ECS data files. In EP4, EOSView will provide a preliminary scripting language, the ability to display simple file structures and interpret HDF Vgroups (groupings of records within HDF files), display of metadata and HDF annotations, pseudo color display of 8-bit raster images and multi-dimensional arrays with pan, zoom, palette selection, and simple animation.

User authentication

CSMS-CSS Object Services security services will be used for authentication of users for EP4. Users will be authenticated and group privileges will be authorized for the evaluation of EP4.

4.3.2 EP4, SDPS Prototypes, Client Subsystem

Advertising Service

This part of EP4 would come from the Advertising Service Prototype. The Advertising Service is a collection of objects implementing the client subsystem interfaces to the advertising services and representing them on the user interface screen. They include:

- advertisement objects (representing service offers)
- provider objects (representing providers of services)
- data product objects (representing the data products related to the service offers)

These objects will be shown as a combination of HTML pages as well as Motif icons and text.

Scientist Workbench

The Scientist workbench is based on the desktop, that is, the workbench objects are subtypes of the basic objects classes provided by the desktop. The workbench objects offer an environment for accessing and managing a user's view into the EOSDIS data and services. The prototype for the Scientist workbench provide evaluators with a candidate desktop environment for interacting with EP4.

4.3.3 EP4, SDPS Prototypes, Interoperability Subsystem

Interoperability Infrastructure

This part of EP4 will come from the portion of the Advertising Service Prototype which interfaces to the interoperability infrastructure provided by CSMS. In building towards the Release A interoperability infrastructure, the Advertising service prototype will exercise the capabilities provided by a CSMS trader.

4.4 Prototype Workshop 1

Evaluation of prototypes demonstrated in Prototype Workshop 1 will be incorporated into EP5. Potential prototypes for PW1 are :

Client Subsystem: User interfaces for requesting Inventory Search, Guide Search, and Directory Search

Data Server: Data Type Services providing Inventory, Guide, and Directory access

4.5 SDPS Content for EP6

In EP6, the following major services will be delivered as SDPS increments for evaluation by the users :

- Additional EOSView functionality for 24-bit raster images, ECS extensions to the HDF format, and more extensive scripting capabilities.
- Data type services for inventory searching integrated with browse, guide, directory, and text search.
- Access to heterogeneous data servers within the EDF using Data Management Subsystems services and prototyped Data Server interfaces.
- Incremental release of the Advertising service and Interoperability Infrastructure interfaces prototyped in EP4.
- Prototyped user self-registration service for guest users.
- Prototyped access to inventory, browse, and guide services of the Version 0 ESDIS system.

Detailed objectives will be provided during the objectives definition phase for EP6.

4.6 Prototype Workshop 2

Evaluation of prototypes from Prototype Workshop 2 will provide input into remaining functionality that will be developed for Release A. Potential prototypes for PW2 are :

Client Subsystem : User interfaces for requesting Product Access, Product Processing, and Request tracking.

Data Server Subsystem : Prototyped Data Type services for providing a response to a request for Product Access.

5. CSMS Deliveries by EP

5.1 CSMS Development Plan Overview

5.1.1 Introduction

The Communications and Systems Management Segment accomplishes the interconnection of users and service providers, transfer of information between ECS (and many EOSDIS) components, and system management of all ECS components. It supports and interacts with the Science Data Processing Segment (SDPS) and the Flight Operations Segment (FOS).

At its highest design level, CSMS consists of three parts:

- **Communications Subsystem (CSS)**

  CSS is a collection of services providing flexible interoperability and information transfer between clients and servers. CSS services correspond loosely to layers 5-7 of the Open Systems Interconnection Reference Model (OSI-RM).

- **Internetworking Subsystem (ISS)**

  ISS is a layered stack of communications services corresponding to layers 1-4 of the OSI-RM. CSS services reside over, and employ, ISS services.

- **System Management Subsystem (MSS)**

  MSS is a collection of applications which manage all ECS resources, including all SDPS, FOS, ISS, and CSS components. MSS directly uses CSS services.

Table 5-1. CSMS Subsystems

CSMS Subsystems	Subsystem Service Superclasses
Communications Subsystem (CSS)	Object Request Broker Services Object Services Common Facility Services
Internetworking Subsystem (ISS)	Data Link and Physical Services Network Services Transport Services
Systems Management Subsystem (MSS)	Common Management Services Management Application Services Managed Object Template Services

5.1.2 Development Track Allocation

The CSS is wholly allocated to the Incremental track. CSS infrastructure capabilities required to support the incremental track will be done incrementally to provide those services required to

SDPS and FOS activities allocated to the incremental track or EP prototyping. Additional prototyping and incremental development will be done to ensure maturing technology is progressing at a pace for required CSS service delivery time frames. MSS may use the incremental track to provide its System Management required for IR1 and release A. ISS is not planning to do incremental development.

5.1.3 Release Planning/Schedule/Considerations

Table 5-2 provides a characterization of the CSMS Service Superclassess by Release for Interim Release-1 and Release A for the two subsystems to be developed incrementally. This information provides a background for understanding the end point for the incremental build-up of services for Release A.

Table 5-2. Characterization of Service Superclasses by Release

Subsystem Superclass		Major Component	IR-1	A
CSS	**ORB**	Interoperability framework		RPC via CORBA interfaces
	Object Services	Interoperability Services	DCE core services via CORBA interfaces	Essential object services added (e.g., archive)
	Common Facilities	ECS-Specific Comm. Services	Heritage applications via CORBA interfaces	Other essential applications added
MSS	**Common Management Services**	Management Framework:	DME 2.0 precursor	Same
	Management Application Services	• MUI - Management data RDBMS - Compatible applications	Mostly network management COTS applications as available for above framework Shadow-manage V0 WAN	Same, plus limited data collection and analysis capabilities for system management Manage ESN WAN at V0 sites
	Managed Object Template	MIBs from COTS vendors	Per IETF/SNMP	Per IETF/SNMP

5.1.4 Dependencies (e.g. COTS Selection)

In the CSS subsystem, the key COTS item is DCE which available from several vendors. (including a beta version of DCE for SGI). A planned DCE 1.1 release will be used by EP6. For ORB Prototyping, HP ORB+ in early development release will be utilized initially with commercial release expected in January 1995. Additional ORB prototyping may be done with products such as SUN DOE. DCE Encapsulation prototyping will be done with products such as HP's OODCE. As an extension of the DFS (DFS is part of DCE) incremental development, the Andrew File System (AFS) extensions from Pittsburgh Supercomputing Center may be used.

In the MSS subsystem, the management services of Data collection, DB and fault require a COTS package. Availability is TBD. Enterprise Management will be provided by HP's OpenView (for use at least through release A).

5.2 CSMS EP Strategy

The overall CSMS EP Strategy is shown in Table 5-3. The table lists the Increments and Prototypes by EP which will be provided by CSMS. EP5 is the delivery vehicle for evaluation of CSMS increment 1, and provides code for release IR-1. EP6 is the delivery vehicle for evaluation of CSMS increment 2, and provides code for release A.

5.3 CSMS Content for EP4

EP4 will provide CSMS services from increments and prototypes in the following subsystems:

- EP4, CSMS Increment 0, CSS Subsystem
- EP4, CSMS Increment 0, MSS Subsystem
- EP4, CSMS Prototypes, CSS Subsystem
- EP4, CSMS Prototypes, MSS Subsystem

5.3.1 EP4, CSMS Increment 0, CSS Subsystem

SDPS Support

SDPS API Support

- Support for file transfer
- New CSMS APIs (allow DFS, RPC Pipes, FTP)
- Security

DCE/Non-DCE Interoperability

Establish method that non-DCE user/client will use to gain access to DCE services.

- Use of public domain software: MIT Kerberos Version 5 beta 4 (Version 5 release in Sept. ‘94?)
- Establish Kerberos client to DCE security server (port 88), logins validated and tickets issued

Table 5-3. CSMS Increments and Prototypes by EP

EP4 TRR 11/02/94	EP5 TRR 4/95	EP6 TRR10/26/95	REL A TRR 4/01/96
INC 0 Kerberos APIs for SDPS Intercell Network Mgmt Performance **Interoperability** Access Control Lists **Prototypes** ORB DCE Encapsulation Non-ORB OO DCE DFS Mgmt Subsystem **Interoperability** Infrastructure I/Fs (Interoperability Trader [static] component of Advertising Service prototype)	**INC I** DCE DFS Developers Tools and Environment Transaction Processing Mgmt Services Fault and Configuration Enterprise Mgmt -Performance DCE Encapsulation **Interoperability** Integration with Infrastructure API **Prototypes** ORB **Interoperability** Data Server I/Fs (Data Server component of Infrastructure prototype) DFS/AFS	**INC 2** DCE Encapsulation Event Services Replicated Servers Time Synchronization/ Source Common Software Mgmt Services Enterprise Mgmt - DCE Release 1.1 Interoperability Integration with Infrastructure API **Prototypes** ORB ECS to Version 0 Interoperability	CSS Rel A Services as defined by SDS table 6.4.3-1 MSS Rel A Services ISS Rel A Network Services

Improve EP3

Upgrade the CSMS reusable code from EP2/EP3 to incremental status (CM control, SEPG coding/naming conventions) and establish intercell operations.

- EP2/3 Code under CM control using ClearCase tool
- SEPG coding/naming conventions to be used
- Three DCE Cells are running: EP cell, EDF cell, & CSMS cell
- Intercell Operations established with static bindings.
- Intercell Operations established in EDF DCE cells

5.3.2 EP4, CSMS Increment 0, MSS Subsystem

Network Management

Selection of the Enterprise Management Product for Release A and begin performance monitoring and M&O monitoring of EP workstations.

Impact of Enterprise Management Product selection

- Potential porting issues based on selection

- Conversion/porting of features (beyond standard) that we have built into EP3

Performance monitoring of client/server applications

Export Network Management Data to SMS database prototype

Performance monitoring

- file-transfer / RPC timing comparisons by varying file sizes and time of day. Looking at changing TCP window sizes.

- Compare file transfer over various LAN media under controlled loads. Expect to use a test tool to help with controlled testing.

5.3.3 EP4, CSMS Prototypes, CSS Subsystem

ORB Prototype part 1

• Prototype of ORB Technology. Begin prototype of CSMS long-term communications architecture based on ORB technology.

Use of CORBA 1.1 ORB

- Get familiar with an ORB product
- Continue investigating object services as defined by OMG/CORBA
- Demonstrate client/server application over ORB
- Measure performance

Progress

- HP ORB+ product has been running in house Since May 1994. Product release expected in mid ‘95
- Sample Applications running -- DEMOs given
- Too early to measure performance - product immature

DCE Encapsulation Strategy Prototype

• Simulated CORBA 1.1 ORB services over DCE for Release A.

- Look at encapsulating application interfaces requesting object services over DCE
- Gauge how this process will work
- Calibrate effort to provide object services over DCE
- Measure performance
- Isolate SDPS/FOS from technology changeover

Vendor Implementation HP OODCE will be evaluated

- OODCE provides the following Object Services - Naming, threads, security, OMG-like IDL.
- Issues to be resolved with OODCE include:
    - Interoperability Issues

- Server Porting Plans - from HP to DEC, IBM, SUN?
- DCE clients/run time strategy
- C++ library vs. OMG C++; OODCE IDL vs. OMG IDL

Support for Heritage Code over DCE

Prototype of Object passing over DCE - Non-ORB implementation of CSMS APIs to legacy code. Use of DCE Directory and Authentication Services.

OO over DCE: Non ORB (heritage/ FOS: HCL)

- Provide CSMS APIs to H-IPC to allow usage of DCE Directory Service (DNS) and basic DCE Authentication (Security) Service
- Look at object passing over DCE - e.g. , Citibank C++ Libraries, HP C++, HAL Computers (DCE++)
- Work with FOS to define CDS APIs
- Authentication APIs developed with SDPS will be reused

DCE DFS Prototype

Track vendor implementation of DFS, a key technology in data transfer and archiving.

Use of DFS in vendor implementations based on OSF DCE 1.0.3

- Multi-vendor implementations
- Is it industrial strength now?

Compare file transfer via DFS, RPC Pipes, FTP

- Timing, performance, security issues (DFS may not be a mature product yet: too early to test timing and performance)
- Various file sizes
- Various bandwidths

DFS vs. NFS

Progress

- Have DCE 1.0.2 DFS servers from HP installed in EDF. SUN (Transarc) server on order.
- 1.0.3 Vendor implementations expected by late Fall '94 (has enhancements to DFS) -- 1.1 will have additional DFS improvements.

Other EP4 Prototypes

Interoperability Infrastructure I/Fs (Interoperability Trader [static] component of Advertising Service prototype using HP OODCE to allow object passing over DCE)

- ORBs - SUN DOE
- SDPS Data Server I/Fs AFS Extensions with PSC and DFS
- FOS - Infrastructure Evaluations

5.3.4 EP4, CSMS Prototypes, MSS Subsystem

System Management Prototype

• Prototype with CSMS database, data collection and information extraction from History Log and threshold messages from the Enterprise Management Platform

DBMS

- Bring in DBMS (relational/multi- dimensional , and/or Object-Oriented)
- Set up a CSMS data schema and extract information from CSMS History Log and threshold messages from Enterprise Management Platform
- Refine history log collections

Report generator front-end (part of DB package)

- Bring in a COTS report generator
- Develop report formats for evaluation using data from the DBMS
  - graphical displays
  - softcopy displays on screen
  - hardcopy reports

Study performance overhead attributed to the DB package - generate relative timing and performance data.

Statistical analysis (part of DB package).

Progress

- ORACLE has been selected for CSMS use in EP4. ORACLE and tools have been installed on a CSMS development workstation(SUN).
- Initiated system log collections on SUN and HP platforms
- Evaluated vendor MIBs to help refine history log collections, and ~~- now~~ processing log data to store in DB

5.4 CSMS Content for EP5

EP5 will provide services from increments and prototypes in the following subsystems:

- EP5, CSMS Increment 1, CSS Subsystem
- EP5, CSMS Increment 1, MSS Subsystem
- EP5, CSMS Prototypes, CSS Subsystem
- EP5, CSMS Prototypes, MSS Subsystem

5.4.1 EP5, CSMS Increment 1, CSS Subsystem

- DCE Encapsulation
- DCE Development Environment

- DCE Cell Deployment - to mirror planned release IR-1 deployment
- Interoperability with SDPS - Infrastructure APIs
- DCE DFS - Provide DFS capability
- Transaction Processing - provide a threads based processing capability and determine if a true transaction processing requirement exists for release A or B.

5.4.2 EP5, CSMS Increment 1, MSS Subsystem

- Network Mgmt - Performance
- Management Services - Data collection, DB, Fault

5.4.3 EP5, CSMS Prototypes, CSS Subsystem

• ORB- continued ORB prototyping with emerging vendor products such as SUN Distributed Objects Everywhere (DOE). These products or beta releases are pre-CORBA 2.0 compliant.

- Interoperability**:** Data Server I/Fs (Data Server component of Infrastructure prototype) DFS/AFS

5.4.4 Interim EP5, CSMS Prototypes, MSS Subsystem

None specified at this time.

5.5 CSMS Content for EP6

EP6 will provide CSMS services from increments and prototypes in the following subsystems:

- EP6 , CSMS Increment 2, CSS Subsystem
- EP6 , CSMS Increment 2, MSS Subsystem
- EP6 , CSMS Prototypes, CSS Subsystem
- EP6 , CSMS Prototypes, MSS Subsystem

5.5.1 EP6 , CSMS Increment 2, CSS Subsystem

- DCE Cell Deployment - to mirror planned release A deployment
- DCE Encapsulation of interfaces
- Event Services
- Replicated Servers
- Time Synchronization/ Source
- Common Software Facilities for release A
- Interoperability: Integration with Infrastructure API

5.5.2 EP6 , CSMS Increment 2, MSS Subsystem

- Management Services -
- Enterprise Management Services - Expanded

5.5.3 EP6 , CSMS Prototypes, CSS Subsystem

- ORBs - Extended Prototypes of vendor released ORB products (CORBA 2.0 if available)
- ECS to Version 0 Interoperability

5.5.4 EP6 , CSMS Prototypes, MSS Subsystem

None specified at this time.

6. Science Datasets and Science Support Scenarios

6.1 Introduction

EP science datasets are samples of science-related data, obtained primarily from the DAACs, to be used in developing, testing and demonstrating EP functionality. Typically the sample datasets will be used to populate portions of the EP Data Server to allow realistic assessment of client-data server interaction. Sample datasets are chosen based on the planned phasing of EP functionality as well as the expected cost to incorporate datasets into the EPs. For example, exploration of yet-to-be-defined ECS metadata and browse data structures will likely require conversion, possibly costly conversion, of existing datasets from the DAAC formats into ECS formats. Also, incorporation of large datasets in the EPs could result in premature buying of expensive storage. The EP Team working with ESDIS/SDPS representatives determine the phasing of EP functionality and, subsequently, identify and iterate on the candidate datasets. After functionality and datasets are established for the EPs, science support scenarios are constructed to describe possible uses of EP functionality, by a science user, that involve the EP datasets, i.e. a context for evaluating EP science user support. In fact, functionality, datasets and scenarios are all iteratively refined as the incremental design matures, the cost of incorporating datasets becomes better understood, and scenarios are defined with lower level details.

6.2 Dataset Roles and Responsibilities

The ECS EP Team has the responsibility of identifying and requesting from the DAACs sample datasets appropriate for the planned EP functionality. Working together with the DAACs, the ECS EP Team and the DAACs will determine the best approach for transferring the datasets from the DAACs to the EP Team. Conversion of datasets (e.g. metadata conversions) or creation of additional datasets (e.g. creation of browse data) is the responsibility of the ECS EP Team.

The preferred method of transfer is FTP from DAACs to ECS but some datasets may be better transferred on media such as CDROMs or 8 mm tape. For example, if the dataset already exists on widely distributed media then this is probably the best method of transfer rather than arranging a special FTP. No data transferred to ECS for use in EPs will be used for operations or actual science support. EP datasets are used for development and test only.

6.3 V0 Data Migration

Pilot V0 data migration projects are being planned at each DAAC with the goal of migrating sample granules from one dataset at each DAAC. These sample granules are a potential data source for EPs since the criteria for selection includes support for System I&T as well as data diversity (different types of data, levels of data, availability of browse products, data format, satellite and in situ data). The pilot migration project would include data reformatting, metadata reformatting, metadata generation, browse reformatting / generation, supporting documentation and additional material needed to use the data in EPs.

6.4 Candidate Datasets

In EP 4 science users will be able to exercise the advertisement service; whereas in EP6 science users will be able to exercise additional services such as metadata search services, browse service, and ECS to V0 interoperability. Estimated capacities to support EPs 4 and 6 functionality are presented in Table 6-1. The plan is to have high capacity to explore both the advertisement and metadata search services but low capacity (because of storage costs) for the browse service.

Table 6-1. Estimated Capacities for EPs 4 and 6

	Directory	Guide	Inventory	Browse
EP4	High			
EP6	High	High	High	Low

Prototype Workshops 1 and 2 have estimated capacities similar to EP6. Based on the planned functionality and the estimated capacities, candidate datasets for the EPs and Prototype Workshops have been identified as discussed below.

6.4.1 Candidate EP4 Datasets

Advertising Service: EDC and NSIDC dataset descriptions. NSIDC is recommended because of use of NSIDC datasets in EP3. EDC is recommended because of the expected use of EDC inventory in EP6 (see Section 6.4.2 below).

EOSView: Sample of one HDF dataset from each DAAC to demonstrate EOSView functionality.

6.4.2 Candidate EP6 Datasets

Advertising Service: Dataset definitions that include the EP6 inventory.

Search Services: Master Directory for directory-level information; V0 Guide for guide-level information; and EDC metadata, V0 pilot migration metadata, and possibly TRMM-like metadata for inventory-level information.

Browse Service: A few browse products consistent with inventory metadata.

EOSView: Sample of one HDF dataset from each DAAC to demonstrate EOSView functionality.

A major objective of EP6 is to explore technical issues associated with spatial and temporal searches of large inventories. At this time, EDC is the principal candidate for supplying inventory metadata in EP6 owing to EDC's extensive collection of spatial and temporal AVHRR, TM and MSS metadata.

6.4.3 Candidate Prototype Workshop Datasets

Prototype Workshop 1 is planned to focus on search services (directory, guide and inventory) before incorporating these search services in EP6. To maintain continuity, available EP6 datasets will be used in developing prototype search services to the extent that EP6 datasets are available to be demonstrated in Prototype Workshop 1.

Prototype Workshop 2 is planned to focus on product access, processing request, and request tracking services. A few products, consistent with the inventory metadata, will be chosen to allow a user to exercise services starting with the advertisement service and ending with the request tracking service. The few products will likely be a subset of EDC, V0 pilot migration, and possibly TRMM-like products.

6.5 Science Support Scenarios

ECS will create science support scenarios in concert with the ECS Science Advisors and the DAACs that provided the datasets.

6.5.1 EP4 Science Support Scenario

- » Connect to EP4 to receive authentication and privileges
- » Startup Scientist Workbench desktop environment
- » Activate interface to advertising service
  - • Hyper link through available advertisements
  - • Perform attribute searches on advertisements
  - • Retrieve and install list of services onto desktop environment
  - • Execute different types of services from list
    - - Service offerors
    - - Providers of services
    - - Data products
- » Activate interface to EOSView
  - • Apply scripting language to open HDF file
  - • Display simple file structures that show components within HDF such as Vgroups
  - • Display metadata contained within HDF annotations

• Choose for visualization one of the objects representing data (raster, multidimensional, etc.)

- Pan, zoom, and palette selection for raster and scientific data

- Simple animation for raster and scientific data

6.5.2 EP6 Science Support Scenario

» Locate EP LIM and other data holdings via advertising service

» Locate guide documents via advertising service, and search text

» Exercise data dictionary service to clarify vocabulary differences

» Install onto desktop the EP LIM interface from advertising service

» Prepare query involving AVHRR, TM, MSS and other TBD datasets

» Submit query to EP LIM

» Analyze results of LIM search

» Exercise browse service

» Retrieve and visualize browse data

» Prepare V0 query

» Submit query to V0 (via EP LIM) using prototype ECS-to-V0 interoperability

» Analyze results of V0 search

6.6 Prototype Workshop Science Support Scenarios

A subset of the EP6 science support scenario will be used for Prototype Workshop 1 with details to be finalized as the EP6 scenario and available datasets are better defined. For Prototype Workshop 2 an end-to-end scenario will be created for a few products to provide the user the "look and feel" of services from advertisement through request status services.

7. Intersegment EP Interfaces

Interfaces between CSMS and SDPS for EPs are listed in Table 7-1. The table is organized by CSMS Subsystem, Service Superclass and Service Class. The majority of the interfaces are with the CSS subsystem. Table 7-1 is built using Table 6.3.4-1 in the System Design Specification (194-207-SE1-001). Table 7-1 lists only those CSMS service classes which will be available for Release A. The Release A Availability column provides a characterization of the implementation of the services based on information from SDS Table 6.3.3-1 and Table 6.4.3-1. EP implementations may differ from Release A implementations. The right most two columns are specific to EPs. The CSMS EP Plan column describes in what fashion each service class will be developed. The SDPS interface column lists how SDPS will make use of the CSMS provided service classes. In some cases, CSMS will be developing a new implementation of a service class for an EP in which SDPS is using a previously implementation, e.g. ORB IDL.

Descriptions of the service classes are available in the System Design Specification.

Table 7-1. Intersegment EP Interfaces by CSMS Subsystem

CSMS Sub-System	Service Superclass	Service Class	Release A Availability	CSMS EP Plan	SDPS Interface
CSS	ORB	IDL	DCE Encapsulation (RPC via CORBA I/F)	EP4: ORB IDL (Proto) EP5: ORB IDL (inc.)	EP4: DCE IDL EP6: ORB IDL
CSS	Object Services	Event	DCE (via CORBA I/F)	EP4: upgrade of history log API (DCE) EP5: CORBA I/F	EP4: DCE API EP6: CORBA I/F
CSS	Object Services	Naming	DCE Encapsulation (via CORBA I/F)	EP4 Proto used internal to CSMS trader	EP4: no interface EP6: TBD
CSS	Object Services	Security	DCE (via CORBA I/F)	EP4: DCE Encapsulation CORBA 'like' I/F EP5: CORBA I/F	EP4: DCE Encapsulation for access control lists EP6: CORBA I/F

CSS	Object Services	Trading	DCE Encapsulation	EP4: DCE Encapsulation (proto) EP6: DCE Encapsulation (inc.)	EP4: SDPS Advertising service interface to trading service (prototype) EP6: SDPS Advertising service interface to trading service (increment)
CSS	Object Services	Threads	DCE (via CORBA I/F)	EP4, 5, 6: DCE Threads	EP4: as needed EP6: multi-threaded services
CSS	Object Services	Time	DCE (via CORBA I/F)	EP4, 5, 6: DCE Distributed Time Service	not applicable
CSS	Common Facilities	File Access	DCE (via CORBA I/F)	EP4: CORBA 'like' API for FTP, RPC Pipes EP6: add DFS to EP4	EP4: not applicable EP6: used for browse
CSS	Common Facilities	Electronic Mail		EP4: CORBA 'like' API EP6: same as EP4	EP4: not applicable EP6: V0 interoperability
ISS	(multiple services)	(multiple services)		As required to support EPs	Data Transport and OS Access
MSS	(multiple services)	(multiple services)		As required to support EPs	PW2: Request/ Results Status
MSS	(multiple services)	(multiple services)		As required to support EPs	EP6: User Registration

8. EP Integration and Test

8.1 EP I&T Process

The EP Integration and Test (I&T) process focuses on proper functional integration as well as fault elimination from each EP release. As items which are deployed outside of ECS contractor control, EPs undergo I&T to assure an appropriate level of stand-alone robustness. (Note that EP Prototype Workshops do not require the I&T described in this section because they are not deployed.) For EPs, various test and validation techniques are implemented to provide an effective process in finding and eliminating faults. Typically, the faults associated with an EP release can be categorized as follows:

(a) Functional - in terms of the available user tasks and products;
(b) Interfaces - networks, DCE, protocols;
(c) Performance - inefficient utilization of resources over the distributed network.

The development and integration of EP components is part of the incremental and prototyping ECS track. As such, the iterative development cycle requires a decrease in the documentation. In spite of this, the tailored EP I&T process as described herein will provide effective validation for each EP release. Table 8-1 describes the aspects addressed during the EP I&T phase. In addition, the ECS Quality Assurance (QA) and Configuration Management (CM) groups will assist the EP I&T team in the following areas:

QA
- Assistance in reviews and inspections (code, test plans, test reports, etc.);
- Collection of process metrics;
- Assistance in NCR tracking;
- Test witnessing (when appropriate);

CM
- Configuration Management control.

The EP I&T team integrates separate incremental components and selected prototypes into an end-to-end system able to perform Evaluation Package functions. Initially, the Development organization performs early integration of low level components with the I&T organization support and coordination. The integration and testing is performed based on the build/thread plan documented in Section 8.3. The EP I&T organization works with the Development organization to complete testing based on the EP I&T Procedures (Section 8.4). The Development organization is responsible for assisting in problem diagnosis and for correcting software problems. The EP I&T organization is responsible for running the tests and writing the EP I&T Report at the completion of the tests. The results of the Integration and Test stage are documented in a series of folders (see Table 8-2). Figure 8-1 depicts EP I&T process .

Table 8-1. EP I&T Approach

Integration & Test Activity	EP I&T Implementation
Acceptance Test Performed By	Not Performed
Incremental Objectives Verified	Objectives, Metrics and Acceptance criteria from Incremental Development Objectives Folders Content and Capabilities from EP Strategic Plan (section 4 and 5) Draft Level 4 requirements for the increments, as available
What Integrated	New Incremental Track Components Previously Developed Incremental Components Existing Formal Track Services via Documented, Formal Interfaces Selected Prototypes
Regression Testing	Demonstrate Compatibility of Previous Increments in Delivered EPs
Test Plans	EP I&T Procedures
Test Results	EP I&T Report and Non-Conformance Reports (NCRs)
Event Completion	EP Readiness Review (EPRR)

The EP I&T team's responsibilities include developing the integration and test plans, support of the EP integration activities, execution of independent EP functional testing, and deployment of the EP (to include regression testing). Even though the development organizations are responsible for the integration of the low level EP components, the EP I&T team will support and monitor these activities. Upon completion of the increment integration and test activities, an EP Readiness Review is held initially with program management. The EP I&T Report is reviewed and open problems (associated with failed test cases) are evaluated. EP management and developers must concur that capabilities left out of the EP are acceptable before the EP integration and test stage is considered complete.

Table 8-2. Integration and Test Documentation

Folder Name	Folder Description
EP I&T Report	A report is developed for each EP to identify results of the increment testing. Capabilities successfully tested and capabilities failing testing (and a justification for removing the failed capability from the increment) will be documented. The format for this material is envisioned to be briefing charts presented at the EP Readiness Review. Responsible organization: EP Integration and Test
Development Notebooks	Supporting material describing problem fixes are documented in the existing Development Notebook folders. Responsible organization: Development
Non-Conformance Reports (NCRs)	Problems identified during integration and test are documented in a problem report data base as Non-Conformance Reports (NCRs). The status of NCRs (e.g. open, assigned, closed) and other information are stored and provided to EP reviewers at status reviews. Responsible organization: Integration and Test.

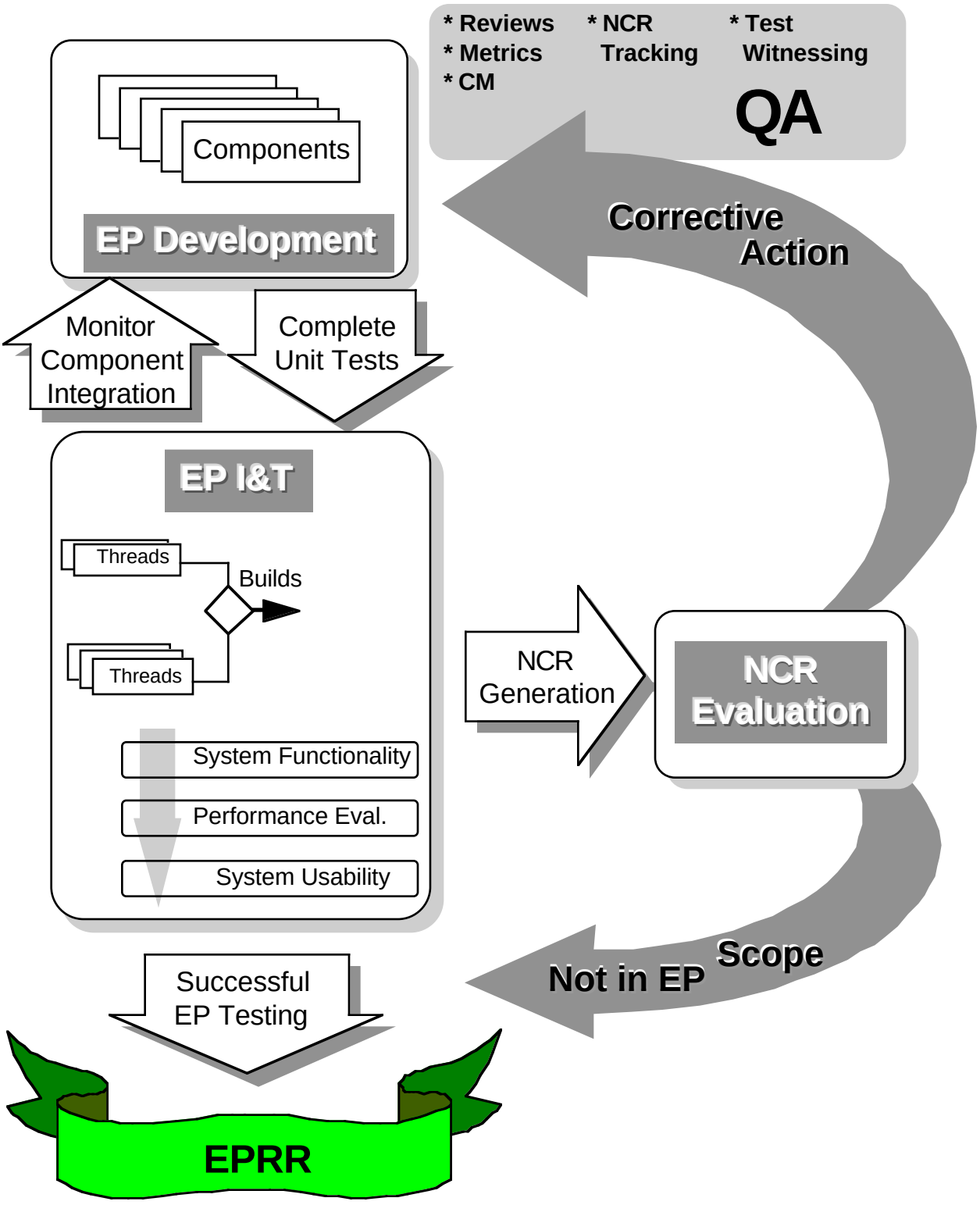

Figure 8-1. EP Integration and Test Process

8.2 EP I&T Organization

During each EP development cycle, an inter-segment team is formed that includes members from the various ECS development and test organizations (Figure 8-2). The EP I&T team contains members of the SDPS and CSMS Segment I&T organizations as well as the IATO and System Test organizations. Table 8-3 describes the roles each of these team players have in the EP I&T effort. The tailored EP I&T process consists of a subset of test and integration phases from the formal track. In general, EP I&T efforts will address the areas listed in Table 8-3. More specifically, the segment developers will be responsible for the unit level tests, while the EP I&T team will focus on system level functional, interface and performance tests on those components that have been integrated.

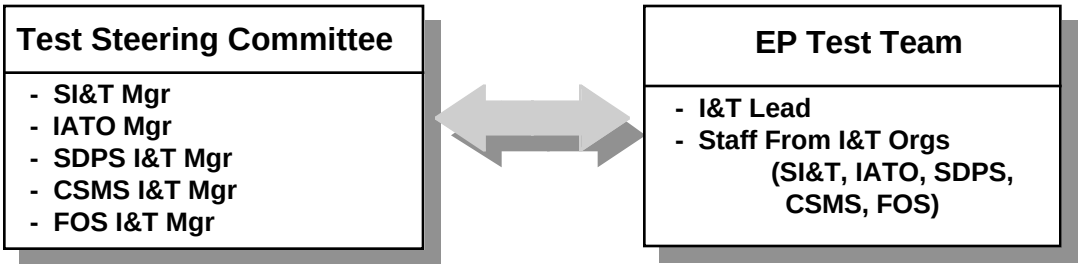

Figure 8-2. EP I&T Team Organization

Table 8-3. EP I&T Roles

Players	Test Type				
	Component Integration & Unit Tests	Functional Tests (Threads)	Integration Tests (Builds)	System & Performance Tests (Scripts)	Usability Testing (Scenarios)
Segment Developers	Responsible				
EP I&T	Assist	Responsible	Responsible	Responsible	Assist
EP Evaluation Leader					Responsible

8.3 EP Build/Thread Plan

The build/thread concept, which is based on the incremental aggregation of functions, is used to plan the EP I&T effort. A thread is the set of components (software, hardware, and data) and operational procedures that implement a function or set of functions. Threads are tested individually to facilitate requirements verification and to isolate problems. A build is an

assemblage of threads to produce a gradual buildup of system capabilities. Builds are combined with other builds and threads to produce higher-level builds. Verification of threads and builds is accomplished at progressively higher and higher levels as the EP is assembled.

The build/thread process allows I&T to occur in parallel with EP development. As components are developed and pass unit tests, they are integrated into threads and subsequent builds. Regression testing of previously integrated components occurs at each build integration to verify the evolving EP components operate as a cohesive product.

The Build/Thread plan for an EP is developed as part of the EP/Increment I&T Plan. Typically, EP Builds and Threads account for a subset of the overall functionality as provided in the ECS Builds and Threads described in the System Integration and Test Plan for the ECS Project (194-402-VE1-001).

8.4 EP Test Plans and Procedures

The EP Test Plans and Procedures document will provide the following information:

- Test Overview - breakdown of the actual tests to be performed (typically a functional breakdown)
- For each test outlined in the overview the document will provide:
  = Test Objectives
  = Test Resources
  = Dependencies (if any)
  = Test Cases
  = Test Procedures for each Case

The actual detailed test case procedures will be provided as part of the EP I&T Test Report. These procedures will be comprised of two parts. One being a script developed and maintained using the newly procured ECS Capture/Playback Test Tool. The second in the form of test operator instructions for the test case configuration setup and execution. In addition, all test cases and procedures will be submitted for configuration control during the entire process.

Test cases will be planned to exercise both custom code and COTS packages. Through the use of the ECS Capture/Playback Test Tool, single-user emulation tests will validate specific functionality while multi-user emulations will provide accurate and repeatable system load and performance tests. In addition, demonstration scripts (e.g., as a precursor to the Usability Tests) will be generated with this tool.

A number of tools will be part of the EP I&T process:

(i) ClearCase Configuration Management;
(ii) Requirements Traceability Management (RTM);
(iii) DDTS for NCR tracking;
(iv) Single and Multi-User Capture/Playback Simulator for functional and performance tests;
(v) OpenView Management Framework;
(vi) Oracle database;

(vii) Instrumented applications (e.g., APIs) as well as custom and COTS log files (e.g., history logs);
(viii) Network Analyzer.

Items (iv) through (viii) listed above will be used in the EP performance evaluation tests. The objectives for these tests is to establish a baseline for the EP network response time under various conditions. For example, network load factors, packet sizes, protocols, and bandwidths will be monitored for transfer rate analysis of various file types and sizes. These evaluations will contribute to the overall understanding of the prototyped networks and their relation to the transfer protocols used.

8.5 EP Test Non-Conformance Tracking

Once developed components are integrated, the EP I&T team will conduct tests defined in the Build/Thread plan that address the EP functional objectives. The EP I&T process will then provide feedback to the developers through the recording and tracking of discrepancies - Non Conformance Reports (NCRs) - during testing. Since the EPs are focused on particular functionality, an assessment of each NCR is made to determine whether it will be corrected within the current EP release. The impact of the error on the EP objectives is the prime consideration in this assessment. In addition, a distinction will be made between NCRs recorded against increments versus those recorded against prototypes. Since the latter are only partially applicable to the EP functionality, only those prototype NCRs directly related to the EP integration will be tracked. An EP Test Report is produced to document the results of the EP I&T activities. This report will also document any known discrepancies in the delivered product.

Table 8-4. Sample NCR Tracking Form

NCR ID #: Test Priority: Test Case Name: Submitted By: Entry Date:	Status: ❍ Open ❍ Closed ❍ Fixed ❍ Duplicate ❍ Withdrawn Priority: ❍ 1 ❍ 2 ❍ 3
Problem Title:	
Problem Description:	❍ Increment ❍ Prototype

Table 8-5. Non-Conformance Report (NCR) Procedure

(T0 Time of problem)	**PROBLEM DETECTED** • Enter the NCR (Developer or I&T) • NCR originator will notify the developer of the problem electronically through the tool itself.
(T1 Next Morning)	**NCR REVIEW (Daily)** • An updated NCR list will be distributed containing all new and updated NCRs from the previous morning. • Originator will describe new NCRs. • Group assesses validity of problem. • Determine Corrective Action if known and estimate of the time to fix. • Group assigns priority. • After meeting, QA updates status of NCRs (priority, risk, status, etc.).
(T2 T0 + 1-3 days)	**BUILD** • Developer Makes Fix • Developer Indicates Action Taken to correct fixed NCR on form. • Notify I&T • I&T will re-build software. • All Fixed NCRs documented with corrective action
(T3 T0 + 4 days)	**RETEST** • I&T Retest for Problems • Regression Test of Affected Components • Results discussed at the next NCR Review.

9. EP Resources

9.1 EP Resources Overview

An overview of EP Resources is shown in Figure 9-1. These resources were used to deploy EP3. No major additional resources are required for EP4

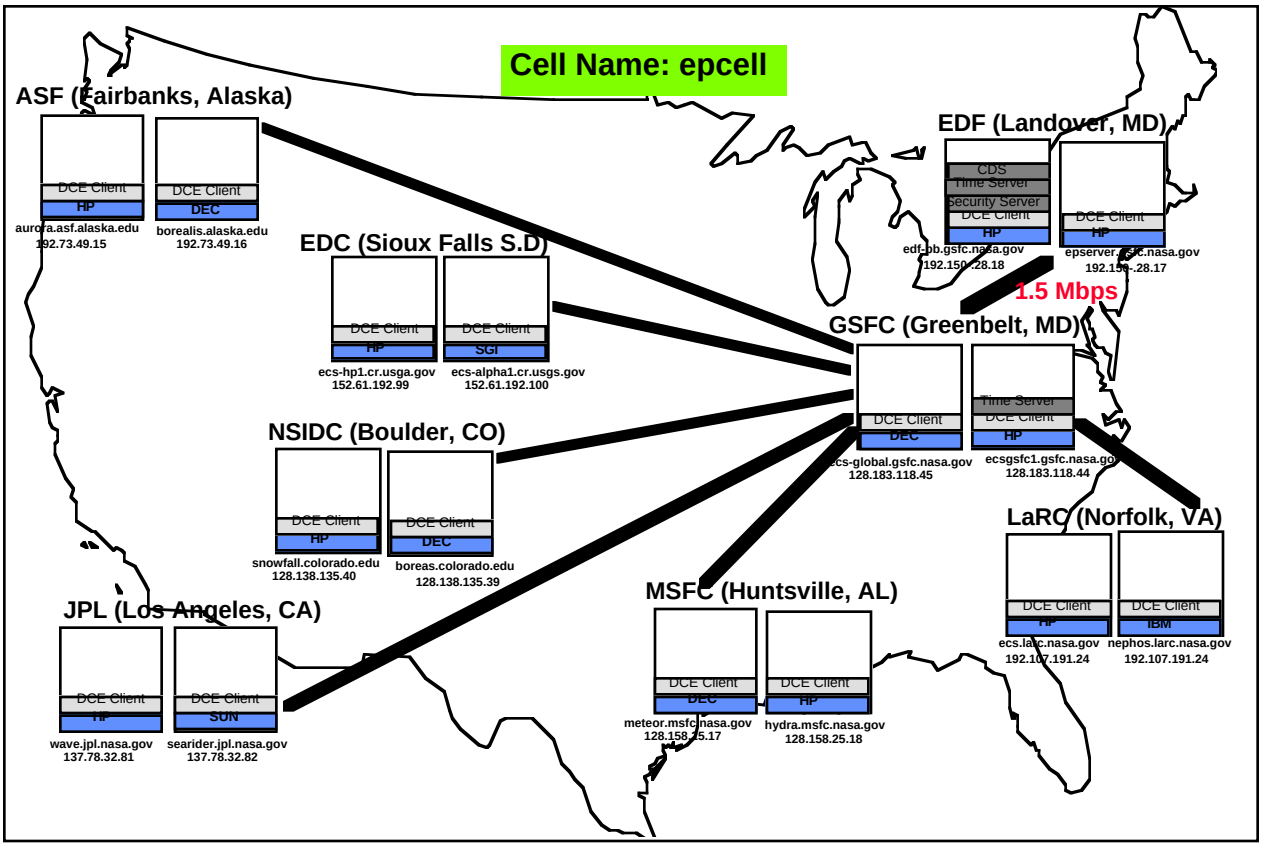

Figure 9-1. EP Resources Overview

9.2 EP Workstations

The main resources for EPs are workstations at the EDF and the DAACs (Table 9-1). The configuration of these workstations is governed by ECS Development Facility (EDF) Policies and Instructions (ECS PI SE-1-002 Draft). These workstations are also used by the ECS DAAC Liaisons for additional purposes.

Table 9-1. EP Workstations

Node	IP Address	Model	OS Version	Location
Borealis	137.229.37.51	DEC 3000/300	OSF/1 Ver. 1.3	ASF
Boreas	128.138.135.39	SGI Indigo/R4000	IRIX 4.2	NSIDC
ECS	192.107.191.24	HP 715/50	HP UX 9.01	LaRC
ECS-ALPHA1	152.61.192.100	DEC 3000/300	OSF/1 Ver. 1.3	EDC
ECS-GLOBAL	128.183.118.45	DEC 3000/300	OSF/1 Ver. 1.3	GSFC
ECS-HP1	152.61.192.99	HP 715/50	HP UX 9.01	EDC
ECSGSFC1	128.183.118.44	HP 715/50	HP UX 9.01	GSFC
EDF-BB	192.150.28.18	HP 715/50	HP UX 9.01	EDF
EPServer	192.150.28.17	HP 735	HP UX 9.01	EDF
Hydra	197.107.196.75	HP 715/50	HP UX 9.01	MSFC
Meteor	192.107.196.74	DEC 3000/300	OSF/1 Ver. 1.3	MSFC
Nephos	192.107.191.25	IBM RS6000/340	AIX Ver. 3.2	LaRC
Searider	137.79.32.82	SUN Sparc10/40	Solaris 2.2 (SunOS 5.2)	JPL
Snowfall	128.138.135.40	HP 715/50	HP UX 9.01	NSIDC
TBD	TBD	HP 715/64	HP UX 9.x	ORNL
TBD	TBD	SUN Sparc20/50	Solaris 2.3 (SunOS 5.3)	ORNL
Trouble	137.229.37.51	HP 715/50	HP UX 9.01	ASF
Wave	137.79.108.188	HP 715/50	HP UX 9.01	JPL

9.3 Networks for EPs

Data communications needs fall into two categories:

- Users will access the Evaluation Package via the V0 network and/or the NASA Science Internet (NSI), a TCP/IP-based network within the Internet. Some users may need to be granted access to NSI.
- A dedicated V0 link connects the EDF and the GSFC campus network, for EP access to the V0 network and the NSI. The link includes the transmission medium itself, terminating multiplexers on both ends, and an interface unit (e.g., bridge or bridge-router) at GSFC.

9.4 Science Data

Science data to be used in EP evaluations are described in section 6.

9.5 Coordination of EP and Formal Release COTS Procurement

COTS hardware from EP3 will be sufficient for EP4. COTS Software beyond that procured for EP4 has already been purchased e.g. XVT for EOSview development.

For future EPs, procurement will be consider in light of COTS procurement for the Formal Releases. COTS Procurement for Formal releases follows dates as recorded in the ECS Level 1 Master Schedule. A summary of those dates in recorded in Table 9-2.

Table 9-2. Formal Track COTS Procurement Dates

	IR-1	Release A
COTS Requirements Defined	11/94	10/95
Final PO Release	3/95	4/95
Final HW/SW Delivery	4/95	6/95
COTS HW/SW Installation	4/95 to 12/95	4/95 to 7/95

10. Evaluation Process

10.1 EP Evaluation Approach

Evaluation Packages are used to make selected functionality available for evaluation and to assist in the refinement of the implementation of that functionality. The EP Evaluation Process is based on three evaluation methods and three user groups.

EPs will be evaluated, and feedback gained on their ease of use and user satisfaction, by means of: Usability Testing (UT), the Evaluator Preference Survey (EPS) and Application Program Interface (API) Evaluation. The usability tests are conducted in a controlled environment that allows for observed and measured response evaluation of design efficiency. The EPS collects user preferences and suggestions in an independent environment at the users' leisure within the bounds of a defined evaluation period. API evaluation will focus on the design, compilation, and use of Application Program Interfaces within the EP framework.

Several user groups will participate in EP evaluation: Science users, Operations and User Services personnel, and ECS Developers. These three different groups were chosen because they may be accessing the EPs for different reasons, will require different EP functionality to suit their needs and an appropriate evaluation method. Each user group will be asked to test the various EP features and capabilities at different stages in EP development.

During the course of the Evaluation Package development there will be a variety of combinations of evaluation methods and user groups (Table 10-1).

Table 10-1. EP Evaluations

EP Event	Evaluation: Method and User Group
EP4	Usability Testing, Science Users Survey, Science Users Usability Testing, Operations and User Services
WS1	Usability Testing, Science Users API Evaluation, Science Users (TBR)
EP5	Usability Testing, Operations and User Services API Evaluation, Developers
EP6	Usability Testing, Operations and User Services Usability Testing, Science Users API Evaluation, Science Users (TBR) Survey, Science Users Survey, Operations and User Services
WS2	Usability Testing, Science Users API Evaluation, Science Users (TBR)

10.2 Evaluation Methods

10.2.1 Usability Testing

The Usability Test will evaluate the efficiency of the HMI designs of the components of EP which includes: EP HMI mockups, user data search specification, data browse, and animation functions. The tests are formulated to evaluate the mocked up user interface capabilities of EP. The data from the tests are compiled, analyzed and then presented to developers where they are used to improve the User Interface (in the designs of windows, layout of screens, buttons, selection parameters, window hierarchies, and help messages). Developers are involved in the UT as observers to obtain first-hand reactions to their products, and also receive the results analysis from the UT to incorporate into future and re-design.

Pretest Preparation

Test Environment: The tests are conducted in the ECS Development Facility (EDF) in a controlled-environment that mimics the environment of a typical user. Test Participants (representative end-users) are selected from the ECS team, DAACs, and the Science community. A Facilitator will coordinate the test and a Timer will be present at the test session to note the time for each step. Members of the Development team will be invited to observe the usability test sessions. To ensure a standard test environment and to avoid hardware biases, all usability tests will be conducted on the same machine, under similar system load.

Task Definition: A series of simple tasks will be defined such that, when these tasks are executed successively all the mocked up user interface capabilities of the EP are tested. The tasks are defined, to include a brief description of the task, the goal of the task, and the instructions or the steps to be performed by the Test Participant for this task.

Metric selection: For each task a number of metrics are measured; a.)Time-to-Perform and b.) user satisfaction rating (usability index). If resources allow, c) error rate and d) task retention are measured. At the end of each task the Test Participant is asked to assign a usability index for the task. The Test Participant assigns each task a score ranging from 1 to 5, where 1 indicates that the user interface for that task is poorly designed and a score of 5 indicates that the user interface is designed well.

Test Operator Selection: Participants with a wide range of experience and various levels of exposure to the EP are selected. The usability tests are conducted with at least 8 Participants in addition to the developers of EP. For example, the Science user group Participants will include scientists who are familiar with the concepts of the EP features being tested but will be using the EP for the first time, scientists with some familiarity with the EP, and Scientists who have used the EP several times. In addition, both Operations and User Services personnel, as well as, API Developers and users will be asked to test the EPs for usability. These two groups will use the EPs in different ways and will require a system adapted for their needs. To determine a baseline, or "best time" score for completing each task to measure the effectiveness of the user interface, the developers will be participating in the usability testing as they would most likely provide the best time-to-perform scores.

Usability Testing Sessions

Participant briefing: Before the commencement of the test, the Participants are briefed about the Goals of Usability Testing and the procedures followed. It is emphasized that the purpose of the test is to test the usability of the software and not them, or their use of the software. The scale (1-5) on which the usability index is awarded for tasks is explained, and the task package containing the detailed instructions and survey forms is given to the user. The Test Participant is encouraged to comment aloud as they execute each task and after the completion of the task.

Actual test: The actual test will last about an hour. The Participants are given one task at a time, and the Timer would note the start- and end-times for each task. Any comments that are made by the Participant are noted by the Facilitator. The developers, who are observing the testing sessions, will watch for problems and opportunities for improvements and note them.

At the end of the test the Participants are requested to complete the Evaluator Preference Survey (EPS) that summarizes their experience testing the software.

Data Compilation and Reporting

At the end of the test, the metrics (time-to-perform and the usability index, among others) are collected for each participant. The maximum, minimum, and the average scores are compiled for each task.

The synthesized metrics, the analysis, the user comments, the potential usability trouble areas, and the recommended changes are compiled in a report. (Reference 4.2.3.2.3) A report will be published after each formal EP review, after the workshops a less formal compilation of results and any statistics collected will be made available.

Usability Testing Roles and Responsibilities

The EP Evaluation Team consists of the organizations and functions responsible for fulfilling the usability testing roles indicated in Table 10-2.

Table 10-2. Usability Testing Roles and Responsibilities

Name	Evaluation	Data Analysis / Report
Developers	• Consult on UT use/design • Participate in UT	• Provide observation note to UT data analysts
Integration & Test	• Consult on UT use and test findings	-
ECS DAAC Liaisons	• Consult on use • Help identify UT Participants	• Assist with understanding of inputs / methods / participation
EP Evaluation Leader	• Conduct Usability Test as Facilitator • Data recording	• Data collection and analysis • EP Evaluation Report prep lead
ECS Configuration Management Office	• Maintain EP Baseline	• Maintain EP Baseline
ECS M&O Office	• Help Desk • EP System Admin. Support	• Help Desk • EP System Admin. Support

10.2.2 Evaluator Preference Survey (EPS)

The Evaluator Preference Survey allows independent use of the EP with on-line, context-sensitive, preference input gathering capability. Evaluation responses are written to a data base which is queried frequently by data analysis personnel to gather evaluation input.

The EPS capability is implemented through a software tool called the Interactive Evaluation Tools (IET) and a Capture/Playback Test Tool. The Capture/Playback Test Tool allows evaluators to run a scripted scenario of the EP functionality without direct ECS personnel support. IET interacts with the evaluator when called from the menu bar or User Survey icon on the EP Executive window. It includes a small set (2 - 5) of survey questions for each of the main EP functions, and provides a free-text input panel at the bottom of each function survey window for the evaluator to record more in-depth comments.

Evaluator Selection

Evaluators for EP are designated by DAAC managers at ESDIS invitation. Their expertise includes earth science, engineering, V0 development, and User Support. Additionally, the V0 Science Advisors have been invited to evaluate EP to lend their special perspective to the evaluation.

Evaluator Familiarization

Evaluators will be given a demonstration of EP functions and methods of operation at the start of the evaluation period using the Science User Scenario Script (using a Capture/Playback Test Tool) as a means of moving through the EP mocked-up functionality. Also, the evaluators will be given a an EP Evaluator Brochure and will have access to local ECS liaison personnel for additional consulting at their request.

Evaluator Exercise of EP

Evaluators are free to explore all facets of EPs and are encouraged to make input of free-text comments on any or all aspects using the IET and the EP. They are requested, however, to execute the Science User Scenario Script at least twice during the evaluation period recording their impressions by answering all questions on the IET survey each time. The two executions of the script should be separated by at least a week.

IET Data Extraction

Evaluator comments and survey responses will be retrieved weekly during the evaluation period by EDF data analysis personnel. All responses will be held confidential by the data analysis organization unless a release form is completed by the evaluator. The release form allows development personnel to contact the evaluator to explore implementation preferences indicated by their comments or to clarify their meanings.

Data Compilation and Reporting

Responses retrieved from the database are analyzed. Those evaluators who have signed releases may be contacted at this time for more information or clarification of their comments. The results from this data analyses are incorporated into the EP Evaluation Report in conjunction with the usability test

EPS Roles and Responsibilities

The EP Evaluation Team consists of the organizations and functions responsible for fulfilling the EPS roles indicated in Table 10-3.

Table 10-3. EPS Roles and Responsibilities

Name	Evaluation	Data Analysis / Report
Developers	• Consult on IET use/design	-
Integration & Test	• Consult on IET use and test findings • Implement Capture/Playback Test Tool	-
ECS DAAC Liaisons	• Evaluate and take IET Survey • Familiarize remotely located evaluators with EP • Fault resolution	• Assist with understanding of inputs / methods / participation • Coordinate evaluator participation • Consult on EP process
DAAC EP Evaluators	• Receive familiarization from Engineering Liaison • Evaluate and take IET survey	
EP Evaluation Leader	• Consult on IET design	• Data analysis • EP Evaluation Report lead
ECS Configuration Management Office	• Maintain EP Baseline	• Maintain EP Baseline
ECS M&O Office	• Help Desk • EP System Admin. Support	• Help Desk • EP System Admin. Support

10.2.3 API Evaluation

Evaluation of APIs will involve the coordination of a number of organizations and groups both within and without ECS. Although the evaluation of the APIs has not been formalized it is envisioned to contain interactive sessions among the API users, developers, EP developers, ECS Engineers and Operations personnel.

Results of the API evaluation will be incorporated into EP Evaluation Report. Pending the decision to develop the CSMS-MSS on an incremental versus formal track, results from the less formal Workshop 2 may be incorporated into a Workshop 2 Results document.

Table 10-4. API Evaluation Roles and Responsibilities

Name	Evaluation	Data Analysis / Report
Developers	Consult on API evaluation use/design	• Provide observation notes to API data analysts
Integration & Test	Consult on API use and test findings	-
EP Evaluation Leader	Consult on API evaluation	• Data analysis • EP Evaluation Report prep. lead
ECS CM Office	Maintain EP Baseline	Maintain EP Baseline
ECS M&O Office	• Help Desk • EP System Admin. Support	• Help Desk • EP System Admin. Support

10.3 Evaluation Groups

10.3.1 Science users

Selection of the appropriate users for each user group are important in order to insure that the results of usability testing, IET Survey, and the API evaluation are robust. Those who will be selected to participate in EP evaluation as Science users will hail from a variety of earth science backgrounds with varying levels of experience with the EPs. NASA representatives, the DAAC Engineering and Science Liaisons, and other scientists will be asked to provide a list of Science User group candidates. A main group in this category are the ECS Science Advisors. Science users will be evaluating both the HCI and API interfaces to ECS.

10.3.2 Operations and User Services

Besides the science users of the EPs there are other groups who represent alternative end users of the system. One of the main groups is composed of Operations and User Services personnel. These users will have different needs and therefore may have different requirements for the EPs. This group of users may do most of their work "behind the scenes," however, they are often the Science Users' only link to the "insides" of ECS. It is anticipated that this group of EP users will spend a significant amount of time interacting with the Science Users and API developers to help them access EOS data and use the ECS. To make sure that the EPs will be able to accommodate this group's anticipated needs they have been included early on in the EP evaluation process.

Operations and User Services personnel participating in EP evaluation will be selected from those at the DAACs and at ECS in Landover.

10.3.3 ECS Developers

ECS Developers will be evaluating the APIs in the Developers Tools and Environment (EP5) as supplied in the CSMS infrastructure. The evaluation will be concerned with the suitability for developing applications to these interfaces.

10.4 EP Evaluation Results Integration

The process of feeding EP evaluation results back into the ECS design process begins with an EP Evaluation Results Forum (ERF), and continues with the use of the EP Evaluation Report as a direct input to the objectives setting and design phases of the next life cycle.

Evaluation Results Forum (ERF).

The ERF is conducted at the EDF by the data analysts to allow them the opportunity to present their findings, to allow developers to explore meanings and intent of indicated directions, and to assure evaluators that their inputs are properly reflected and clearly understood. A summary of the EP Evaluation Report will be presented at this forum, and the report itself will be distributed. The ERF presentation will follow the EP Evaluation Report table of contents as an agenda presenting a summary of each topic.

Those in the local EDF area are welcome to attend in person. Others will be invited to participate via teleconference.

EP Objectives and Design Update.

The EP Evaluation Report will serve as a direct input in the update of the EP Strategic Planning White Paper; the guiding direction for the EP process. An update of the white paper will be made at the end of each EP Evaluation.

EP Enhancement.

Each EP is meant to be a short-lived product that is enveloped by the subsequent EP in a expanding set of functionality. Consequently little effort is planned to enhance deployed EPs except for those fixes required to keep it operating.

The IET will remain in use throughout the time EP is installed. Continued input is welcome.

11. EP Maintenance and Operation

The ECS M&O organization plays a central role in procurement, installation, and check-out of EP COTS hardware and software, providing an EP operations environment in the EDF and at each DAAC, providing wide-area communication necessary to support EP deployment and evaluation, and providing support services necessary to operate and maintain EP evaluation. EPs are delivered prior to a formal release and associated full contingent of ECS M&O Organization. Table 11-1 summarizes the EP M&O Responsibilities.

Deployment of each EP at the DAACs and on host servers at the EDF constitutes a delivery to an unofficial M&O status. As such, basic maintenance and operations functions must be performed. These include COTS, procurement, installation and checkout, operation of a fault detection, reporting, and resolution process, operating system administration, hardware and software maintenance, property management, configuration management, and resource scheduling.

No M&O personnel are planned for deployment to the DAACs until the delivery of release A in 1995. Consequently, until that time, all M&O services in support of the EP process shall be performed from the EDF at Landover, MD with coordination and support from the ECS DAAC liaison personnel.

As the EPs are not an operational system, e.g., they are not fully supported by complete life cycle products, software maintenance is the responsibility of the development organizations.

Hardware maintenance is the responsibility of EDS, through a maintenance contract, for ECS project equipment, and the responsibility of HTSC for Hughes capital equipment.

Operation of the EP Workstations at the DAACs is the responsibility of the ECS DAAC Liaisons with assistance from the ECS EDF Help Desk.

Table 11-1. EP M&O Responsibilities

EP M&O Task	Responsible Organization
Installation and check-out of EP COTS hardware and software	ECS M&O
Software Maintenance	Development Organizations
Hardware Maintenance - Project Equipment	EDS Maintenance Contract
Hardware Maintenance - Hughes Capital Equipment	HTSC
EP Operations	ECS DAAC Liaisons with assistance from the ECS EDF Help Desk

Detailed description of M&O tasks are found in the remainder of this section.

11.1 M&O Evaluation Activities

M&O prototyping and evaluation activities are performed in two categories: those performed to support the activities of the ECS segments, and those performed to evaluate products and procedures for eventual use in ECS M&O functions.

11.1.1 M&O Support of ECS Segment Evaluation Activities

a. COTS product evaluations. M&O performs all actions to:

receive, coordinate, track requests for evaluation products

install, administer?, manage, deinstall, ship evaluation products

perform all procurement activities in support of evaluation products

brief status of all evaluation activities to EP Team management

b. M&O provides computing and communication environments to host all ECS COTS and developed product evaluations.

11.1.2 M&O Function Evaluation Activities

a. ID processes, procedures, policies for evaluation

draft working version documentation

try out in support of EPs

revise as required

b. ID products that could improve M&O efficiency

obtain for evaluation under 11.1.1.a above

11.2 EP COTS Procurement and Property Management

M&O procures and manages all COTS products purchased in support of the ECS Program, including those acquired to support EP computing and communication requirements. This responsibility covers both capital and program funded acquisitions.

11.3 EP COTS Product Installation and Check Out

11.3.1 EDF Activities

a. Initial Installation. COTS products acquired to support EPs are received by the M&O organization at the EDF where they are unpacked, inspected, installed, checked out, and certified ready for use by EP developers.

b. Support to Development and I&T.

c. Shipment. Hardware and software to be shipped to DAACs in support of EP deployments is deinstalled and packed by M&O, and shipping contracts are let.

11.3.2 DAAC Activities

a. Facilities Planning. M&O performs facilities planning and coordination at the DAACs in coordination with facilities managers at each site. They are assisted in this coordination by the ECS Engineering liaison representatives.

b. Product installation. M&O personnel travel to each site to install and check out EP products that require their level of expertise. Some products are installed by the ECS liaison at the site. Determination of method is made by the EP Team prior to shipment.

11.4 EP Configuration Management

Identification of EP hardware and software to an EP baseline is controlled from initial installation at the EDF through final delivery to assure ability to perform maintenance, track changes, and perform property management.

Three baselines are defined for each EP deployed for evaluation (software configurations for those EPs in development are managed by the developer):

1. Hardware Configuration. Defines workstation components.

2. Software Configuration. Defines application software installed.

3. Operating System/Services S/W Configuration. Defines UNIX and DCE set up.

All changes to these baseline configurations must be made under authority of a Configuration Change Request (CCR) approved by the appropriate CCB in accordance with ECS Program Instruction SE-1-002. Change board authorities are:

1. EP Configuration Control Group manages the Operating System/Services S/W Configuration,

2. EDF CCB manages no-cost changes to H/W and S/W configurations,

3. ECS CCB approves all expenditures for EP configuration changes.

11.5 EP Fault Resolution

A process for identification and resolution of faults in EP products has been establish by M&O (Figure 11-1). The process is centered in the EDF System Administrator (SA) and supported by the ECS Help Desk. The process operates from three key concepts:

1. Users need only deal with their local DAAC Liaison to resolve problems.

2. The liaison need only deal with the EDF Help Desk.

3. The EDF System Administrator is the focal point for fault diagnosis and coordination of corrective action.

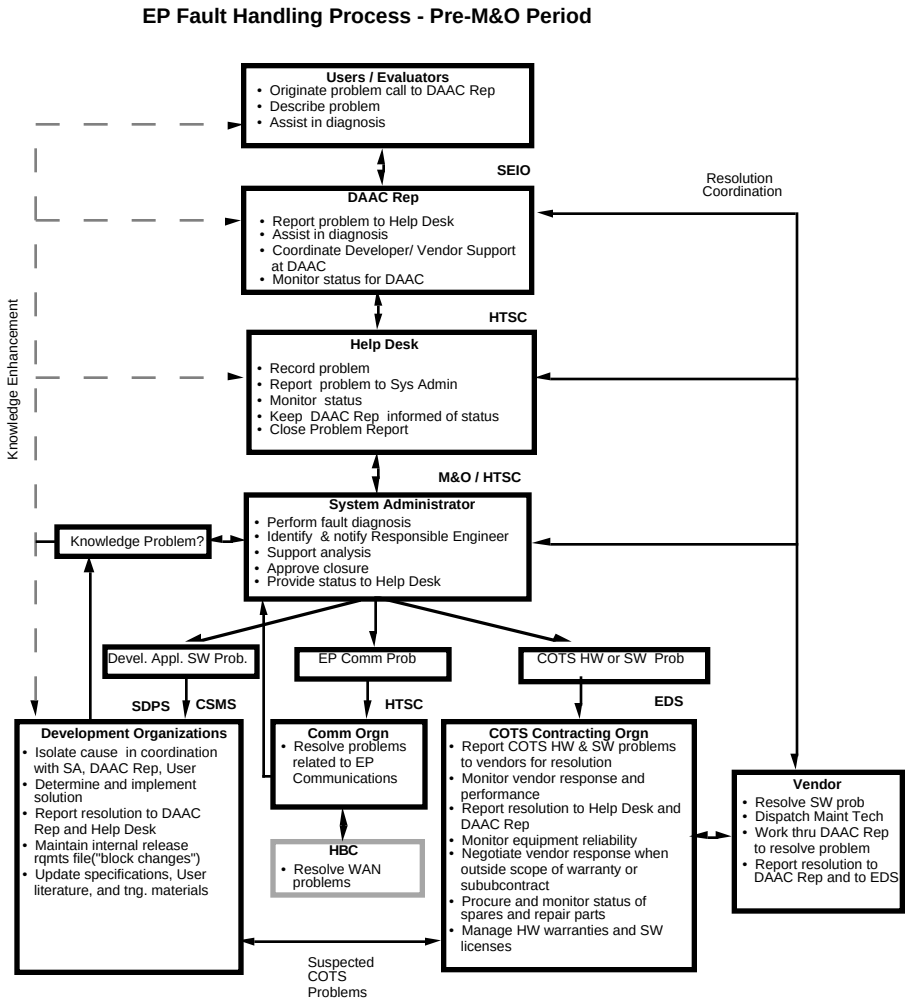

Figure 11-1. EDF Fault Handling Process

11.6 EP System Administration

During the period prior to M&O implementation at the DAACs, System administration for EP workstations is performed centrally by the EDF System Administrator, with selected support from DAAC Liaison personnel.. The EDF SA will produce, distribute, train on, and maintain procedures for local SA operations. Current procedures to be fielded in support of EP2 include:

a. Workstation Storage Backup

b. EP System Security

c. Workstation Shutdown and Reboot

d. Addition and Deletion of Users

e. DAAC System Configuration Modification

f. Installation of Software

g. Superuser Privileges

h. Workstation Housekeeping

Close cooperation must be practiced among the DAAC liaisons empowered to perform SA functions and the EDF SA. Our current plan allows all liaison personnel access to root functions to gain most efficient operation. All persons performing SA functions must exercise restraint and good judgment to avoid unnecessary system reconfigurations or builds. DAAC liaison personnel should always coordinate any planned change with the EDF SA before they perform it, and the EDF SA must always inform DAAC liaisons before making changes to the DAAC machines.

Abbreviations and Acronyms

AFS	Andrew File System
API	Application programming interface
ASF	Alaska SAR Facility (SAR: Synthetic Aperture Radar)
CM	Configuration Management
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off-The-Shelf
CSMS	Communications and Systems Management Segment
CSR	Consent to Ship Review
CSS	Communications Subsystem (CSMS)
DAAC	Distributed Active Archive Center
DB	Data Base
DBMS	Database Management System
DCE	Distributed computing environment (OSF)
DD	Data Dictionary
DDTS	Distributed Defect Tracking System
DFS	Distributed File System
DME	Distributed Management Environment (OSF)
DNS	DCE Directory Service
DTR	Development Team Representative
ECS	EOSDIS Core System
EDC	EROS Data Center (EROS: Earth Resources Observations System)
EDF	ECS development facility
EDS	Electronic Data Systems
EOS	Earth Observing System
EP	Evaluation Package
EPRR	EP Readiness Review
EPS	Evaluator Preference Survey
ERF	Evaluation Results Forum

ESN	EOSDIS Science Network
ETM	ESDIS Technical Manager
FOS	Flight Operations Segment (ECS)
ftp	file transfer protocol
GSFC	Goddard Space Flight Center
GUI	graphical user interface
HDF	Hierarchical Data Format
HMI	Human-Machine Interface
HTML	HyperText Markup Language
HTSC	Hughes Technical Services Company
I&T	Integration and Test
I/Fs	Interfaces
IATO	Independent Acceptance
IDL	Interface Definition Language (OMG's CORBA Implementation)
IDL	Interface Definition Language (OSF DCE Implementation)
IET	Interactive Evaluation Tool
IP	Internet Protocol
ISO	International Standards Organization
ISS	Internetworking Subsystem (CSMS)
JPL	Jet Propulsion Laboratory
LAN	local area network
LaRC	Langley Research Center
LIM	Local Information Manager
M&O	Maintenance and Operations
MD	Master Directory
MIB	management information base
MIT	Massachusetts Institute of Technology
MSFC	Marshall Space Flight Center
MSS	Systems Management Subsystem (CSMS)
MUI	Management User Interface
NCR	Non-Conformance Report

NSI	NASA Science Internet
NSIDC	National Snow and Ice Data Center
OMG	Object Management Group
OODBMS	Object Oriented Database Management System
ORB	Object Request Broker
ORDBMS	Object Relational Database Management System
OS	Operating System
OSF	Open Software Foundation
OSI	Open Systems Interconnect
PGS	Product Generation Subsystem (obsolete ECS element name)
PI	Project Instruction
PSC	Pittsburgh Supercomputing Center
PO	Purchase Order
QA	Quality Assurance
RDBMS	Relational Database Management System
RPC	Remote Procedure Call
RTM	Requirements and Traceability Management
SDPS	Science Data Processing Segment
SEPG	Software Engineering Process Group
SGI	Silicon Graphics
SI&P	System Integration & Planning
SNMP	simple network management protocol
SOW	Statement of Work
T1	a common-carrier data pipe providing 1.544 Mbps of capacity
TBR	To Be Reviewed
TCP/IP	Transmission Control Protocol/Internet Protocol
TRMM	Tropical Rainfall Measuring Mission (joint US-Japan)
TRR	Test Readiness Review
UT	Usability Testing
V0	Version 0 (of EOSDIS)
WAN	wide area network